THE
ELECTRICAL REVIEW.

VOL. LXI. OCTOBER 4, 1907. No. 1,558.

ELECTRICAL REVIEW.

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LIGHT PRODUCTION AND ILLUMINATION.

THE chief object of the illuminating engineer is to look along the line of processes culminating in electric or gas lighting, in the reverse direction to that taken by engineers having the more orthodox point in view. That is to say, the illuminating engineer takes the illumination produced as his starting point, and from that he works back to the engines and boilers, or to the scrubbers and retorts necessary for the process. This is the direct reverse of the old attitude, which took coal as the basis and worked onward towards the maximum production of light.

The newer view is undoubtedly the more correct scientifically, but it is already in danger of being unduly limited in effect by the assumption of too complete a knowledge on the part of illuminating engineers. Distribution curves and tables of candle-feet are all very well for the relative comparison of known illuminants, but it must not be forgotten that the twin sciences of light production and illumination are as yet in a most chaotic state. A paper by J. H. Hart, Ph.D., recently appeared in *Cassier's Magazine*, showing the unsatisfactory nature of our position in this matter. He starts with the preface that to the majority of illuminating engineers no distinction is drawn between the production of light and the problem of illumination, these being two propositions involving different conditions and employing different standards. Light can be produced in large quantities with very small illuminating power, and *vice versa*.

Perhaps nothing indicates so much our lack of knowledge of the subject as the way in which the writer deals with analogies. Such useful illustrations are good for inexact general knowledge, but betray an absence of accurate and final information. Dr. Hart's argument with regard to light production can be traced almost wholly by his analogies. For example, he writes, "we know now that light is some form of electrical energy or a magnetic manifestation in the ether, or both, but this does not help us to any great extent in our management of the ether and our production of light. We would encounter the same difficulty with water in its utilisation in hydraulic press work, and in its other applications, if we had nothing with which to grasp it but instruments as porous as fly-screens. This is the situation in regard to the ether. Ether travels through ordinary matter very much as the wind does through trees. It takes a very rapid motion of the molecules themselves to produce a disturbance in the ether."

From this the writer derives that "the problem of light production is a problem of the control of all the motions of the individual molecule in any substance. It can be said, off-hand, that this has never been accomplished directly. It is accomplished indirectly, but with a loss in efficiency that

is appalling. Thus, we can drop a heavy block of lead several hundred feet, and when it strikes, a portion of the energy is transformed into sound, but the proportionate amount of energy utilised in this development is a very small percentage of the whole. We would hold an analogous position in sound production if this were our only method of producing sound and musical notes," with the further complication that only a few of the total ether waves produced are perceptible to the eye. "As an illustration of this further complication, it can be assumed that when a rock is dropped, a number of musical notes or noises are produced. If we had an ear susceptible only to a small fragmentary portion of the sound which is actually produced, this would be a much closer analogy to the phenomenon of light produced." Passing on to the expense in energy required for our present processes, we are given another analogy—"It is very much as though we should try to play an organ where a large power plant was required to operate it, and, in some cases, a separate plant for the production of each note. This represents the situation almost exactly."

At present, heat is the only practical means of developing light. Heat is known to be the motion of the molecule, either as a whole or in part. The motions of the whole molecule produce, as a rule, wave-lengths too long for the motion to be perceptible to the eye as light. It is generally by the impact of molecules with one another that extra rapid motions are set up which produce light rays. The light production problem is to select molecules of such structure that they will vibrate readily for the peculiar wave lengths visible to the eye as light, and to produce such motion in them as to get a good percentage of the energy applied, converted into light energy. This problem is only at its inception, and the knowledge regarding it is at present fragmentary.

The twin subject of illumination is quite as perplexing. Inasmuch as it deals with the nature of the eye, its various purposes, and the utilisation of light with reference to the power of the eye, it bears the same relation to the production of light as medicine does to surgery. Medicine is empiric; surgery is exact. In the course of time it is to be hoped that light-production will become an exact science, but illuminating effect will be largely a matter differing in each individual. So far as research and experiment have gone, we know that the varying colour of light is due to differing etheric-wave lengths; that such wave-lengths combined give new colours. Combinations of various waves are analogous to musical chords, and their effects on the eye are somewhat similar to those of musical chords on the ear. Some wave lengths—not necessarily visible—rapidly tire the eye. Thus a wood or coal fire gives off etheric waves invisible to the eye, and produces a smarting sensation. White light is a peculiar combination of the various wave lengths in various amplitudes of the waves. Electric light has a large excess of ultra-violet as compared with sunlight. Ordinary gas burners have a large excess of the longer waves compared with the same standard. For reading close print, one kind of wave length or a certain combination of waves is peculiarly fitted. The mercury vapour light produces wave lengths of large illuminating power for some purposes, but very objectionable for others, because of the limited wave lengths of the light. Certain portions of the retina are very sensitive to blue light, and when the light is faint this is the light to which the eye first responds. No artificial light compares in every respect with sunlight. The problem of illumination is the consideration of the purposes for which light is needed, and of the methods of adapting wave lengths to this need, with a possibly greater theoretical range than can be obtained with sunlight.

This point of view is obviously far away from that of the average man with the photometer, who makes simple tests on 16-c.p. lamps. It shows us that it will probably be years before the amount of knowledge concerning illuminating engineering will be sufficient to render operations in this field at all commensurate with the development in other spheres of engineering activity.

The "Electrical Review" and a Proposed Union of Electrical Interests.

The *Times* Engineering Supplement of the 2nd inst. contains the following:—

Union of Electrical Interests.—We have received the following for publication:—With the object of finding a remedy for the present state of things in the electrical industries, it is proposed to form a Union of electrical interests. With this view the editors of the various electrical journals have been approached to take the initiative and to act as an organising committee until sufficient support has been obtained to enable a representative council to be constituted. It is intended to extend the invitation to join the Union to everyone who is interested in electricity, whether as shareholder, consulting engineer, manufacturer, contractor, or trader—whether employer or employé. The Union is to start without any political bias, and with neutrality as regards municipal trading and other like matters. The proposed procedure is, when sufficient subscribers have been enlisted, to classify the subscribers according to the branches of the industry in which they are specially interested, and to ask each branch to elect one or two members of a provisional council. It is intended to make the annual subscription 2s. 6d. per member.

We shall be glad to learn that the Union proposed is productive of good to the electrical industry, but since the approaching of the Editors of the various electrical journals has been specifically mentioned in the above published announcement, we owe it to our readers that we should state that the information before us regarding the proposed Union is not such as to justify our joining in taking the initiative with which the various Editors are credited. Needless to say, we should be glad to place before our readers at any time particulars of any well-considered plan with definite objects, and to make such comment upon such plan as its merits may seem to require.

Wireless Telegraphy.

Certain daily papers are very busy with the announcement of Mr. Marconi that he will commence his trans-Atlantic service this month, and appear to be doing their best to discredit cable shares, with what object we do not know. Such a course cannot be said to be intended to benefit the public, though it may put money in the pockets of those who know how to seize the opportunity.

We do not doubt the successful transmission of signals across the Atlantic; we know, in fact, that at least one other wireless system besides the Marconi accomplished this feat many months ago. The development of the service to the point at which it becomes efficient enough for public use is only a matter of time and labour, with capital at command. But there is no reasonable ground for a scare. The slowness of transmission by wireless telegraphy prevents a single installation from carrying as much traffic as a single cable; it is not independent of atmospheric conditions, as a cable is—and it will not do to hold back messages received in the daytime, for transmission by night; and above all, wireless telegraphy is not secret.

An official of the Marconi Co. is reported to have said that if the business increased beyond the capacity of the Clifden—Cape Breton stations, others would be erected, but that they would have to be at least 100 miles apart. There is plenty of room in Canada, but how many stations can be accommodated in the United Kingdom on this scale of density?

We hear that in the future—a safe date—the trans-Atlantic wireless system will transmit at the rate of hundreds of words a minute. No one can say that this is not conceivably possible; but we prefer to talk about what *is* rather than what *may* be, no one knows when. Similarly some means may conceivably be found, by which secrecy may be obtained for wireless messages. In the meantime, it is well for the commercial world to know that any wireless message can be tapped with ease, and there is no practical system in view for removing this objection.

THE ACCIDENT TO SYDNEY TRAMWAY FEEDERS.

[In our issue of September 20th, page 470, we published a note from our Sydney correspondent relating to a breakdown in the Sydney tramway service consequent upon the dragging of a feeder cable by a ship's anchor. We are now able to publish the following fuller account by our correspondent, together with photographs illustrating the occurrence and the repair.]

On August 7th at 1.50 p.m., the service on the North Shore tramways at Sydney, N.S.W., was abruptly interrupted, and on investigation it was found that faults had developed on both the high-tension feeders running from the Ultimo power house to the North Sydney sub-station. The North Sydney service had a portion of the lines running electrically before the electrification of the main city service, and at that time had a power house of its own. Soon after the Ultimo power house was constructed, a pair of low-tension feeders was run across the Harbour from Dawes to Milson's Point, and subsequently when the high-tension machinery was introduced into the Ultimo power house, the North Shore power house became a sub-station, being fed by a pair of high-tension cables running from Dawes Point to MacMahon's Point. Both these cables were found to be faulty when tested, and it became necessary to resort to temporary expedients in order to maintain the service. In a very short time a partial service was restored on the low-tension feeders with the old steam plant at North Sydney, and before evening, by arranging positive and negative

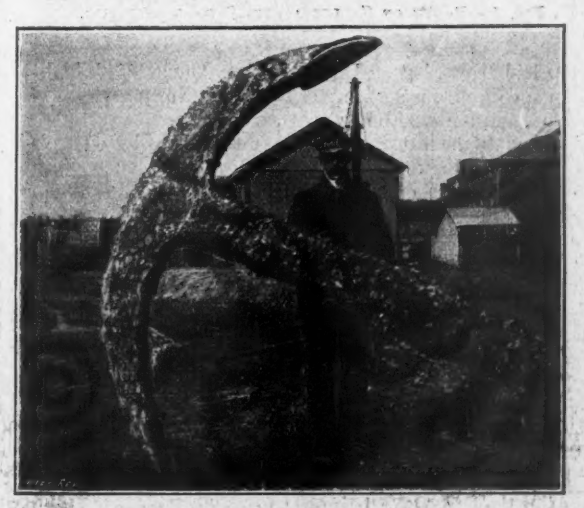


Fig. 1.—View of Anchor found attached to Cable. Mr. Dixon standing alongside.

boosted feeds from the city sub-station and Ultimo power house, a practically full service was maintained. The whole of this work was carried out by the Railway Commissioners' electrical staff without a hitch or a wrong connection, and was a very smart piece of emergency work.

About the time the interruption occurred, it became known that a large steamer had been observed in trouble off Miller's Point. She was coming in under easy steam, and on arriving at the point was met by the full force of the worst squall of a westerly gale which had suddenly arisen, and was driven down stream and across the harbour towards Milson's Point. She dropped an anchor, but still dragged nearly over to Milson's, and it is surmised that she dragged her anchor right across the H.T. cables. The anchor then held, presumably on the cables, and getting under steam again and hauling on her anchor she again went forward, and apparently carried the cables with her up to a point near Goat Island, where she managed to get rid of them somehow.

When the tests showed that both submarine cables had broken down, it was at once decided to haul up the cables and rectify the faults, if possible. These cables are of the three-core type, and were manufactured and laid by the British Insulated and Helsby Cables in 1902-3. They are run at 6,600 volts, but being made according to the Commissioners' specification, were much more heavily insulated than is a standard 6,600-volt cable. Each core is 37/16 S.W.G. The cables are paper-insulated, lead-covered, juted, then pro-

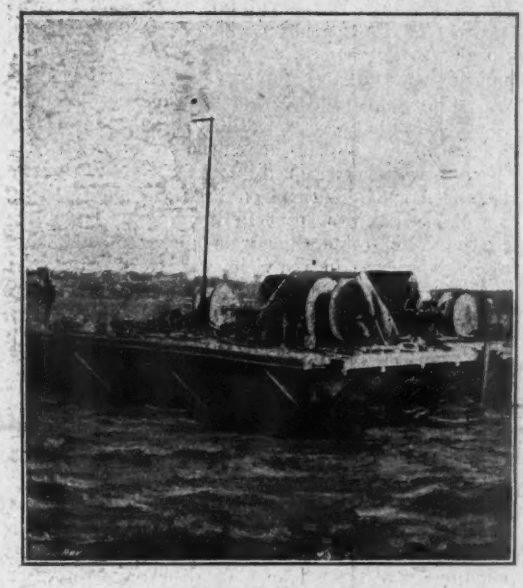


Fig. 2.—Punt on which Joints were made and from which Cable was laid.

tected by two layers of wire armouring consisting of a total of some 135 No. 11 galvanised steel wires, and again juted, making up a weight of about 50 yds. to the ton. The shortest length of track, keeping to moderate depths, is some 750 yards, making a total weight of 15 tons per cable for the distance. In laying the cables originally, the contractors decided on making the cables in 100-yard lengths and jointing *en route*. As far as the writer knows, there is no precedent for the making of 6,600-volt H.T. joints to withstand 40 to 45 lb. water pressure, and at the same time to sustain a strain of from 1½ to 2 tons on the armour joint when completed, and consequently some difficulty was met

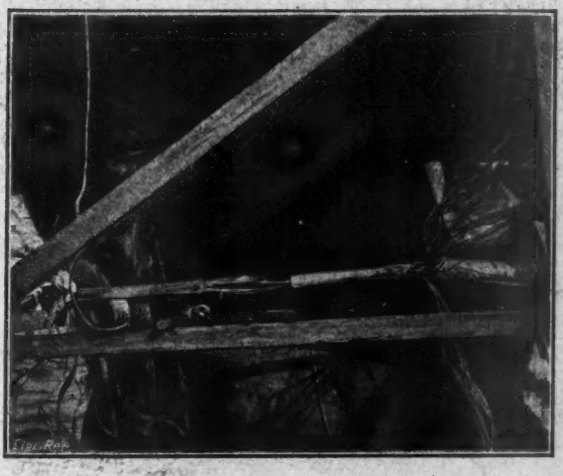


Fig. 3.—Making a Joint on the Punt.

with in making the original joints. These difficulties were, however, overcome by the contractor, and the cables have lain since 1903 up to the date of the accident and performed continuous service without any signs of trouble. The electrical joint is the ordinary telescope joint insulated with coiled tapes, with a lead sleeve wiped on and filled with oil. This is placed in a galvanised iron box with stuffing boxes for the cable to pass through, these boxes being packed with jute boiled in bitumen. The armour is spread and clipped between two galvanised steel rings which are bolted together with eight bolts on each side of the joint. The two rings

are then bolted together with four 1-in. steel bolts, which take the longitudinal strain during laying, and subsequently off the lead joint.

On looking for the shore ends at Blue's Point they were found to be "not at home," having been torn right out. On Thursday morning, therefore, a pile-driving punt and a small steamer with jib and steam winch were obtained from the Harbour Trust, the ends were taken out from Dawes Point and the work of hauling in was started. A fault was found about 100 yards from the shore near one of the joints, where the cable in the pulling about had had a severe twist, and the next length hauled in showed the broken end of the cable. The other cable continued intact for some 400 yards, when its broken end also came on board. On Saturday a good part of the day was spent in dragging for the stray detached lengths of cable which were known to be loose in the harbour somewhere in the vicinity of Goat Island. A diver was sent down on a likely catch, which eventually proved to be the cables, so a rope was sent down and a bight of cable hauled up. Towards the evening, however, the hauling gear found the task too heavy and refused duty, and as just about this time it came on to blow hard, making it difficult for a diver to go down in such an exposed position, operations were suspended until Sunday morning. At 6 a.m. a diver went down and reported that the cables were badly mixed up with a large anchor which they had apparently picked up in their travels across the harbour. A rope was made fast to this anchor, and up it came with about 90 ft. of heavy chain and with one cable round the tripping shackle and one round the fluke. This anchor is shown in the illustration, fig. 1, p. 555. This was cleared, and the remainder of the cables came aboard without further incident. On this remainder, however, were found two large whorls of outer armour, the piece between these whorls being very badly flattened, showing that there had been a very severe strain on the cable at some time, and that some force had been reeving the cable through or against some very hard and solid object. Two lengths of cable came up showing

Fig. 4.—Two of the Kinks found in the Cable.

extraordinary sharp twists of the cable, and as these are particularly stiff cables it can be readily imagined that considerable force was necessary to bend the cable to this extent. These two twists are shown in the accompanying view, fig. 4.

The whole of the cable was carefully overhauled, and any portion deemed to be of service was pressure-tested afloat, the barge being moored opposite Dawes Point and a lead slung over from the shore and connected to the 6,600-volt H.T. feeder, and it speaks well for these cables that after five years' service under water they withstood the 11,000-volt testing pressure without any trouble whatever. A good deal of cable which was otherwise in very fair condition was spoiled by water, and in other cases a great deal of cable in which the paper was dry was so mangled as to be useless. A quantity was salvaged, however, which, with a length or two of spare cable and a short length of single-armoured high-tension cable obtained in Sydney, made sufficient for one length across the harbour on the original route.

Ten lengths were used, and as each joint takes some 20 hours to complete, it was a matter of several days to get the

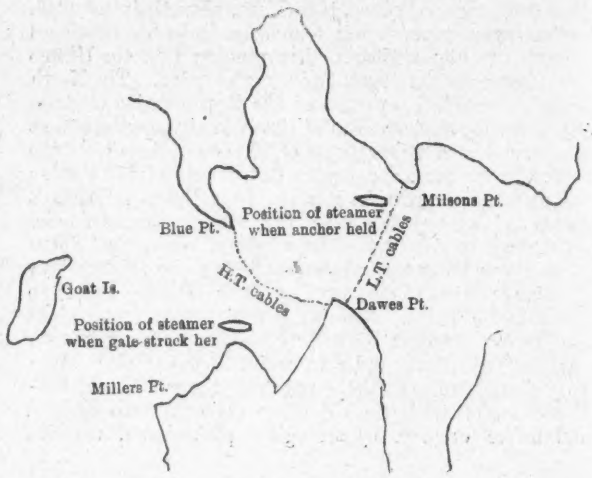


Fig. 5.—Route of Cables across Sydney Harbour.

cable laid across, but on Friday evening, August 23rd, high-tension current was again available at the North Shore sub-station, and the service now runs as usual.

In laying the cable, the drum was mounted on stands bolted to the deck of the punt and held by a brake applied to the periphery of the drum; the cable from this ran along the deck through a loose rolling hitch to the leading duct over the side. During jointing the weight was taken off the duct by a stopper run over the side of the punt, holding the weight of the cable at the water's edge. This stopper is payed out during the process of getting a joint overboard until the joint comes to a position just ahead of the leading duct, when it is picked up and lowered over the side, a running rope through a strop on the joint taking the weight of the joint until it touches bottom, when one end of the rope is loosed from the deck and hauled through the strop by the other end, the cable at the same time being replaced in the running duct. Fig. 3 shows the operation of jointing.

The whole of the work was carried out under the supervision of Mr. J. E. Dodds, who laid the cable originally for the British Insulated and Helsby Cables, Ltd., and is now practising in Sydney as a consulting engineer, the departmental engineer-in-charge being Mr. Dixon, who may be seen in fig. 1 standing alongside the anchor.

Wear of Turbines.—A well-illustrated serial article on the wear of hydraulic turbine runners and guide vanes has been published recently in *l'Eclairage Electrique*. Many examples of severe corrosion are given, the damage apparently being due largely to chemical action rather than to mechanical attrition. Some of the views, indeed, show extraordinary effects, the iron edges—or the places where the edges used to be—being extremely rough and apparently spongy. Hardly less severe wear has been observed on substituting bronze for cast-iron, but the character of the injury is quite different, the worn parts being smooth. Francis turbines, again, show results very different from those which occur with "action" wheels. The author, M. J. Dalemont, attaches much importance to the formation of small but violent eddies due to the mode of regulation and to the shape of the vanes and guide blades; it is noteworthy that in the Francis turbine, where the water is not liable to such disturbance at the *outlet*, this part is practically immune. In the buckets of Pelton wheels but little wear is found, although the jets of water act at a very high velocity; in the distributing nozzles, however, severe corrosion is met with. Chemical analysis and photomicrographic examination failed to furnish conclusive evidence as to the cause of the corrosion, the difficulty being that the portions actually corroded had, of course, disappeared. Summing up, the author ascribes the action to eddies, producing mechanical disintegration, rather than to chemical effects.

THE CORRECT FORM OF TRAMCAR.

As years roll by, the style of Mr. Wm. R. Bowker becomes easier. There was a time—but, no, we will hide our agonies. He writes in *Cassier's* that because there is a Kelvin law relating to economy of conductors, there must be a similar law which should be made to govern the "numerical proportioning of different types and sizes of tramway cars as used by electric tramway undertakings." The determination of that law is left to mathematicians; nevertheless Mr. Bowker finds no difficulty in applying the law without discovering it, for he concludes by strongly advocating the more general adoption of the single-deck car, and says that, under ordinary circumstances, "one type (and one type only) covers the economic law of proportion, viz., the combination single-decked car."

It is really a great pity that we cannot take Mr. Bowker as seriously as he takes himself, for in this matter at least we incline somewhat to his opinion, which, by the way, seems to be the opinion of the majority, that the greater use of single-decked cars would have been beneficial to electric tramways as a whole; but it is difficult to avoid laughing at a writer who opens by claiming previous ignorance of the question as a virtue, and practically assumes that "tramway advisers, consulting experts, committees and managers" have given it as little previous consideration as he. "The writer has never seen any information or suggestions in print dealing with this subject, and, so far as he is concerned, it is an entirely new one, and the ideas, conditions and discourse are original."

We are willing to believe that Mr. Bowker's information is limited, and that he is out of touch with the general conditions of tramway working in Great Britain, but those facts give him no particular right to speak three times of the "gross error in judgment made by tramway undertakings by generally adopting the double-decked car."

Mr. Bowker writes at length of the conditions which govern the most useful type of car, and with no regard whatever to conditions, instances the invariable use in the U.S.A. of single-deckers as a further proof that "British tramway undertakings in general have not studied the proposition on the lines suggested in this article."

We disagree totally with the writer's recommendation of the adoption in a large city, or in any other kind of place, of four different types of car to suit the winter and summer weather, or slack and rush traffic, and we think that the average tramway manager will keep on producing an average type of car which will suit the average conditions both of traffic and weather, without worrying about any mathematical determinations which, from the nature of the case, are likely to be less nearly correct than the common-sense decision of a purely practical man who keeps his eyes open and does not neglect his traffic statistics.

The shapes and sizes of omnibuses, hansom cabs or jaunting cars were determined—if such a precise term can be applied sensibly to processes of evolution—by no consideration of x and y, and it is not possible for any ordinary mortal to say how or in what particular the shape, size and general design of any vehicle were the results of the whim of an inventor, the command of a master, or the pressure of the public.

Undoubtedly the British public likes its top-decked cars, likes them big when the track is not too good, and likes them covered when it rains. From the point of view of the tramway, the single-truck, double-decked roofed car is the best money getter, and so long as the permitted maximum speed does not exceed 15 to 20 M.P.H., we expect to see no decrease in the popularity of this type of car with owners and users. For higher speeds, such as rule in the United States, the single-decked car is a necessity, and the time may come when it will be the British type as well, but for our part we think that a very keen "foresighted look into the future," as Mr. Bowker has it, will be needed if that date is to be fixed with any certainty.

MANUFACTURE OF IRON TUBE FROM WROUGHT-IRON INGOTS.

It is well known and fully recognised that wrought-iron is much superior to steel in respect of its resistance to corrosion. This is especially the case with fencing, with wires exposed to weather, and, above all, for engineers, with boiler tubes. But the trouble with iron has been the difficulty in securing the iron in large enough ingots and arranged for solid-drawn tubes. Iron is also very much more reliable than steel for such purposes as crane hooks, drawbars, anchors, chains and anything which is safer when made from a non-homogeneous material which will not fail all the way through as soon as a minute crack commences in its external parts. The lack of homogeneity is what makes wrought-iron so much safer, because a non-homogeneous substance like a bar of puddled piled cut and repiled and repeatedly re-rolled iron is more like a bundle of wires than a solid casting, and though some fibres of a wrought-iron bar may fail, this failure does not extend to other fibres. For tubes, however, the great virtue is the resistance to corrosion.

But it is necessary to make a wrought-iron tube practically weldless. A tube welded up from thin strip is apt to be burned at the weld, being, therefore, of unequal thickness, and to be cold shut in the weld, and, therefore, liable at any time to fail.

Inshaw's patented system of wrought-iron tube construction consists first in providing an ingot welded solid in the mass, so that, after the weld is made, the tube is rolled. The weld is made in the ingot and on a large surface at full welding heat and under heavy pressure, so as to preclude all chance or possibility of failure or of cold shut. On a heavy ingot the pressure can be properly applied.

In order to make the solid ingot, Mr. Inshaw rolls a slab, which presents the appearance of a heavy thick hollow cylinder, in which radial cuts have been made, reaching nearly to the circumference. One cut comes right to the surface. The slotted cylinder, if then laid flat, will be like the Inshaw ingot as shown in fig. 1. Such an

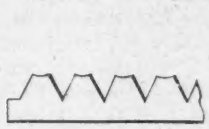


Fig. 1.

Fig. 2.

ingot, rolled with the proper number of projections at the correct angle, will obviously fold up into a perfect circle, fig. 2. The flat ingot raised to welding heat is thus folded in a special welding mill and compressed between suitable rolls, and comes through as a solid ingot from which pipes can then be rolled.

According to the *American Machinist*, wherein the system of manufacture is described at page 763 by Mr. W. H. Booth, the new tube is rendered possible by the ability we now possess of mechanically handling wrought-iron in heavy masses. In brief, mechanical puddling is now a success, and large ingots can be made. Rolling machinery is powerful, and plenty of work can be put upon faggoted blooms, and any desired excellence of quality secured by the single process for sufficiently working good raw material.

Much of the bad wrought-iron of old days was bad from lack of sufficient heating and piling and rolling. The cinder was not squeezed out sufficiently, and too little mechanical work and pressure was applied, and probably much stuff was rolled at too low a temperature, which did not get rid of surplus cinder.

Wrought-iron boiler tubes are what have long been sought. They can now be made by the new process. To South Staffordshire, the home of Bradley's Best, the new hope for wrought-iron comes as a particular boon.

Norwegian Water-Power and Foreign Capital.—The King of Norway gave his consent, according to a Christiania correspondent, at a sitting of the State Council on September 12th, to the Bill passed by the Storthing in relation to the utilisation of water power. It is provided under the new Act that embankment and deepening works for the regulation of a water course, even if the cession of soil and land that are not one's own is not required for the execution of the works, cannot be taken in hand without previously obtaining the consent of the King, as soon as the water power used by the undertaking for industrial purposes is increased to at least 3,000 H.P. During the proceedings in the Storthing, in respect of the regulation of the Miosen Lake—the largest in Norway—the Opposition to the Government did not conceal that in contesting the Government's decision they were materially concerned with rendering it as difficult as possible for foreign capital to "exploit" the rich water powers of the Glommen for industrial establishments. The Opposition even went so far as to accuse the Government of injuring the interests of the country for the advantage of foreign capitalists. Immediately on the day following the victory of the Government in the matter of the Miosen Lake scheme, the Opposition brought in a motion which has now become law by the giving of the King's assent, as already mentioned. This motion was adopted by the Storthing without noteworthy discussion, although it was opposed by the Government on the ground that the proposal represented a rupture of all traditional customs and an interference with private rights in property. But the Government itself had already embarked upon this path by having established the completely new principle for Norway that the natural riches of the country represent, in a certain measure, State property, and that the State has the right of utilising these riches for its advantage. The correspondent recalls in this connection the fact that in the spring of this year a wealthy German company, which wished to acquire the whole occurrence of ore near Salangen in Finmark, was compelled to pay 36,000 kronen to the State for the grant of the concession. In addition to this, a Swiss company obtained permission to utilise the water power of the Kinserbach only on the express condition that the whole installation should revert to the State free of charge at the expiration of 75 years. The correspondent adds that foreign capital scarcely runs the danger under the present Ministry of being burdened "any more than necessary," but he predicts a bad time for foreign capitalists when the present Opposition become the Government of the day, and they are now preparing a plan of campaign with the object of securing the political control of the country.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Co-operation in the Electrical Trade.

With reference to the correspondence which has appeared in your paper since the publication of your editorial notes on the above subject, we are carefully tabulating the various points raised, and in view of the fact that so many of the writers fail to disclose their identity, we propose answering them through the medium of your valuable columns, at a later date. In the meantime, we might say that we have received from various quarters a number of hints and suggestions of a most practical and useful character, as also the most satisfactory offers of support to the scheme so soon as it shall have further developed.

Wholesale Electric Traders.
C. S. Northcote.

London, S.W., *September 30th*, 1907.

The advantages of co-operation have long been set forth by enthusiastic advocates, and numerous proofs of those advantages have been given. In view of such results it is not surprising that in some electrical circles there should seem to be a hopeful ring about the proposal which you are permitted to set forth in outline. You invite your readers to complete the sketch by elaborating some of the possibilities. But before the elaboration has proceeded far I should think that most of your readers would join you in the scepticism which seems to run through your comment, and many would reach the conclusion that the proposal is hopeless.

Notwithstanding the admitted successes of co-operative societies, there is a tendency for such concerns to fall away from the co-operative principle and to degenerate (in the language of the co-operative enthusiast) into mere ordinary business concerns, selling to all who will buy, or at least taking no particular trouble to restrict their businesses within the limits of their memberships.

But the hopelessness of the proposal made seems to lie in the fact that it goes beyond any previous suggestion in the co-operative world. To succeed co-operators must co-operate for kindred purposes. The most usual, because the soundest in principle, is that retail purchasers should combine to make a wholesale purchase where the distribution can be effected with ease and economy.

But the electrical co-operation proposed apparently contemplates the enrolment of the buyers and sellers in the same organisation, and herein lies its undoing. Can such co-operation be applied so as to remove any appreciable part of the present difficulties? I do not believe it could be applied at all, and if it were applied, I do not think it would have any effect in ameliorating the situation. Let me anticipate the contention which will inevitably be raised, that more incongruous associations have existed than that which is now proposed. No doubt. I read a week or two ago that the wayfarers in one of your London suburbs were interested observers of a man, a dog, a cat, and a bird taking a walk together. But it need only be said in answer that we must count on the usual rather than the unusual, and I think it will be held that it is at least unusual for buyers to co-operate with sellers to increase the latters' profits, or for sellers to co-operate with buyers in reducing prices. That such co-operation is absolutely impossible no one will say. There is much unconscious co-operation between apparently conflicting interests under the competitive system of the day, but conscious co-operation cannot be expected until the inherited antagonism of buyer and seller is partially eradicated, and that may come, but cannot be expected in time to remove the "present" difficulties of the electrical trade.

Regarding those difficulties, may I suggest for consideration the question whether the electrical trade dwells a little too much on its ailments? The constant talker about his aches and pains is a ready prey to quack nostrums, and the constant advertising of trade depression may help rather to prolong than to amend the existing situation. Whatever other causes there may be, great expectations unrealised must be an important contribution to such depression as may exist. But what is there in the electrical trade which should justify it in expecting that any exceptional steps will, or can, be taken to help it out of its difficulties? Preparation for an unrealised demand is practically the same thing as over-production, and must pay the same penalty.

Manufacturers want more orders and better prices. Electricity suppliers would be glad to see the demand which would justify them in putting in their orders for machinery, but, like good business men, they would rather do it, if they could, in a free market at a time of low prices, than join in a co-operative movement which limits their area of purchase, and has for its main object the improvement of the position of the manufacturer.

Let manufacturers help themselves and let purchasers help themselves by means of associations if they like, but the associations must be as absolutely distinct in *personnel* as they are in their objects. Anyone who has had experience of associations is aware that they exist with difficulty even when the membership is that of kindred spirits with kindred objects. The attempt to combine in one association heterogeneous elements will probably fail. If it succeeds, experience should lead us to expect a speedy dissolution.

X.

September 20th, 1907.

Mr. Northcote's letters, and the plan outlined by him, of applying the principle of co-operation as a means for remedying certain of the ills with which the electrical industry is beset, encourage me to submit a suggestion.

Manifestly there are strongly defined limits within which alone it is practicable to conciliate the conflicting interests of different trade sections and of their units. Initiative and enterprise will not be baulked, and firms are not likely to entrust control of their prices and methods to an independent organisation, however representative. Indeed, the ultimate good of the cause would be badly served by restricting healthy competition amongst home industrials, whose prosperity it is "the" intention to promote.

Granted all this, I contend that the possibilities of united action for mutual benefit are still abundant, provided the widest basis is selected on which co-operation can be rendered effective. The greatest scope for such a purpose, to my mind, is afforded by mutual finance.

Consider, in the first place, the most consistent friends of the home manufacturers, *i.e.*, the firms of electrical contractors—what are the conditions met with in all parts of the country? In many instances the prosperity of these concerns is hampered, not by a lack of work to undertake, nor by energy to secure contracts and ability to carry them out successfully, but by financial limitations. The original working capital becomes gradually locked up in stock and in contracts executed, the payments for which latter, unfortunately, are often withheld for months after the installations have been completed. New work, consequently, cannot be taken in hand until the proceeds of former contracts are available; trading on credit entails paying higher prices for materials, &c., than if these had been bought for cash in the open market. Bankers, as a rule, will not agree to overdrafts, except against tangible security, and they cannot, therefore, be counted upon for the facilities required. It follows that much of the principal's time is taken up in endeavouring to collect outstanding accounts in order to keep matters going, instead of being able to devote fuller attention to the development of his business.

Here we have one formidable cause of stagnation reacting in turn on every section of the industry, and tending to restrict efforts. Exhibitions, publicity, even Parliament, are of no avail against the slow payer, who will always be with us if he gets the chance. By financial co-operation alone can it be expected to overcome this disability. For this purpose, then, as well as for many others, I advocate the establishment of a co-operative industrial bank, administered under a committee of contributors, elected periodically, and on which the Council of the I.E.E. should also be represented.

Unlike the German "Handels Banken," which support

certain large companies alone, funds from the co-operative industrial bank would be at the disposal, at any time and upon equitable terms, of all well-reputed firms of electrical engineers, who would be numbered amongst its shareholders.

An institution of this character, in my view, has every prospect of conferring substantial benefits on the home industry by fostering business and facilitating dealings between subscribers.

The value of your space forbids more than a brief sketch of what I consider should be the main objects and rules of such an establishment, and an outline of its scope which would enable the undertaking to be self-supporting almost from the outset :—

"To render available additional working capital to contributors of sound standing, for work secured or specific purpose, on security of own contracts backed by other outstanding accounts, first proceeds of either to go towards clearing transaction.

"To purchase with such funds on behalf of contributors the principal plant or materials required and selected from catalogues of shareholders in United Kingdom, paying spot cash on certificate. This will benefit home manufacturers, avoid losses through delayed delivery, reduce cost of collecting accounts, and minimise risk of bad debts.

"To give contributors full benefit of preferential trade terms which the bank will enjoy as buyers on a large scale. The cash discount to be the bank's consideration.

"To promote the employment of sound materials and good work, thus forestalling disputes, and to stand by subscribers when these arise.

"To assist in the more expeditious collection of accounts outside the electrical industry ; to act as clearing house for overdue inter-electrical accounts tending to avoid legal and bankruptcy proceedings against subscribers capable of meeting their liabilities with adequate assistance.

"To act as buyers and shippers for foreign and Colonial subscribers ; transact ordinary banking business, money exchange, &c.

"To keep no stock whatever, to abstain from competition in any shape with contributors."

Branch offices in the North of England, Scotland and Ireland could be opened to facilitate closer touch with subscribers without entailing unduly increased establishment charges. Clients, obviously, would wish to maintain best relations with the bank, which, with its influence fully recognised in due course, could not fail to become the central point at which the interests of buyers and sellers meet.

I submit the above suggestions in the hope that they will prove of some assistance in bringing about that prompt and sustained betterment in the condition of the home electrical industry for which most of us are waiting.

L. B.

Illuminating Engineers.

We have naturally been greatly interested in your leader in the issue of 27th inst. on the above subject, and are particularly pleased to be able to report to you that anticipating your suggestion that manufacturers should publish a series of curves showing the distribution of light from their fittings, we had an independent report made on our fitting by the Manchester School of Technology as far back as August 24th, 1905, and have distributed many thousands of copies of this report to various customers and embryonic customers. We are enclosing a copy of the said report herewith.

pp. **The Linolite Co.,**
A. S. E. A.

London, S.W., *September 30th*, 1907.

The Tonbridge Appointment.

After Mr. Plunkett, of Oban, was appointed to his present position at Tonbridge, a letter, or letters, appeared in your paper from one of the unsuccessful candidates, hinting how much better he was than the successful candidate. I have just learned that I got the credit for this very modest communication, and I hasten to state that I (as you are aware) never wrote, or caused to be written, any letter to your paper concerning the Tonbridge appointment. There were four chief engineers and one chief assistant on the short list, and I would suggest that those who did not write to your paper write now and say so.

I may state that I was satisfied that the Tonbridge Council appointed whom they thought best for the position. I am not even acquainted with the record of Mr. Plunkett, therefore it was not in my power to compare myself with him in any way, even if I had wished to do such a silly thing.

A. J. Abraham,
Resident Engineer, Lanark County Council.

Cambuslang, *September 25th*, 1907.

Glasses Supplied Without the Juice.

I enclose a copy of a letter received from an up-country customer on the subject of a value-payable post transaction, which took place between us. It is a fair sample of many that we get, and I am sure will prove of interest to your readers.

N.B.—The "glasses" were as described, bought by him as such from our catalogue.

Walter Locke & Co., Ltd.
E. Threlfall Vickers,
Manager, Electrical Department.

Calcutta, *September 5th*, 1907.

Stranger's Telegraph Training and Typewriting School,
Benares City.

Dated *August 30th*, 1907.

To Messrs. Walter Locke & Co., Ltd.,
Locke Buildings, Calcutta.

Dear Sirs,—I received your parcel containing three glasses with three holders for electric light. On opening the parcel, I tried these glasses to be lighted up by six Leclanché strong cells, but to no effect.

At last I have kept them packed, and am writing you for instructions that how shall I get them lighted, which battery is required, and how many. Reply sharp, or will return the three glasses with three holders to you back, as they are useless to me. The V.P. was of Rs. 7/14/-, and railway freight I gave -/4as./-. An early reply solicited, with instructions. And if you have got the suitable batteries for these glasses, write with price each, will get from you. Kindly inform "That how many battery will light one glass," then by that proportion I shall issue orders. The glasses you sent to me are of 32 C.P. 225 volts, at Rs. 1/8/- each. And I did not receive any amperes in the parcel. If you charged for it, inform, send invoice also.—Yours faithfully,

(Signed) P. Prasada, *Manager.*

The Improvement of the Small Power Load.

In your current issue you draw attention in several places to the desirability of inducing the public at large to take up electric heating and the like. It is certain that the use of small power appliances in this country is comparatively small, in view of the fact that in almost every town of any importance in Great Britain a supply of electric energy is available, frequently in charge of capable engineers very anxious to sell it. We may make this fact a theme for speculation concerning the conservatism of the British public, or lay it at the door of the gas competitor, but it is better to consider how to remedy it.

The purveyors of almost every kind of commodity except electric energy have discovered that there is far more money to be drawn from the pockets of the masses than of the classes, not only for necessaries, but for luxuries. It has been shown to be quite possible, and very lucrative, to persuade persons of extremely restricted means to purchase voluminous and learned encyclopædias ; though opinion is divided as to whether these should be classed as necessaries or luxuries, or in some third category. No such doubt exists as regards electric energy, at any rate, among the profession best qualified to judge. There is one rule of success for this sort of trading, however, which is as the historic laws of the Medes and Persians ; a mere allusion to the sale of encyclopædias has disclosed it—it is, don't ask for money down !

This disposes of the possibility of any wide extension of double wiring. A builder is not asked to install a duplicate set of gas or water pipes in new houses, nor does a householder have to submit to a plumber-invasion if he wishes to install gas stoves.

One of your contributors suggests the estimation, or "approximate measurement" of the consumption of a power appliance used on a lighting circuit. But if rules and

regulations as to accuracy of metering mean anything, this will hardly be permissible. Besides, the class of consumer we wish to reach will certainly be the last to agree to his bill being a matter of estimation on the part of the supply authority; and if a deduction from his meter record be agreed upon, he will see the wisdom of burning gas for warmth and enormously reducing his electric lighting bill. Hour counters are very little use, for the consumption of current by most appliances is either variable at will, or varies with time. Last, but not least, we are one step nearer that fast approaching state of things, when there will be as many systems of charging for electricity as there are users thereof.

If we charge for current on a flat rate we must differentiate between power and lighting consumption. The only way to do this without separate wiring is by using sub-meters. The objections have hitherto been (1) cost; (2) increased risk of metering error, and of disputed accounts. If any single meter goes wrong, the whole account is in doubt. Small errors may add up. There are minor objections on the score of appearance in private houses. The sub-meter must therefore be accurate, permanent, inconspicuous, easily read, and much less in first cost than a full-sized meter. The writer has elsewhere described a modification of the mercury electrolytic meter, which is an attempt to meet the essential requirements.

So far, the suggestion has met with a very favourable reception from supply engineers. The question has immediately arisen as to how the system is to be applied to the case of consumers charged on a demand indicator system. The answer is simple—the two systems are opposed in theory, and no practical amalgamation of them can be completely satisfactory. As, however, the flat rate is itself far from being theoretically equitable, there is no telling what *modus vivendi* human ingenuity may not devise. The proper way to supply a demand indicator consumer with power is to install a time switch to cut out his indicator during the day; and the result is the best of all possible systems, and one not costly to install. Of course, the tariff must be correctly fixed; if, for example, the lighting tariff be 5d. and 3d., and power be offered at 1½d. or 2d., the system is inapplicable, because the demand tariff is incorrectly fixed.

H. Stafford Natfield.

Brighton, *September 29th*, 1907.

"Hiko" Commutator Compound.—We are again asked for the name of the present suppliers or makers of this compound.

THE ENGINEERING AND MACHINERY EXHIBITION.

Machinery exhibitions are now of such frequent recurrence that it becomes increasingly difficult to say anything new of them. There is, however, something new about the Engineering and Machinery Exhibition now being held at Olympia, London. The novelty is not so much in the exhibits as in the exhibitors, who appear to have partially acquired what might be called the "motor manner."

When a mere layman visits a motor-car exhibition, he, as a matter of course, expects that the stall holders, or exhibitors' managers—they are all managers nowadays—will treat him with that air of lofty condescension and that pitying patronage which are the attributes of the very superior person in describing to the ordinary plebeian engineer the fearful and wonderful intricacies of the modern motor-car.

Exhibitors of the commoner kinds of machinery, such as are represented at the Engineering and Machinery Exhibition, are rapidly acquiring the motor manner, one characteristic of which appears to be that it is considered the worst possible form on the part of the stand attendant to describe or explain to a visitor any detail of an exhibit, unless the said attendant has the stump of an oft-lighted cigar between his teeth, or the fag-end of a cigarette sticking to his lower lip. To remove this, or even to permit it to be out, whilst talking to a visitor, is the height of impropriety. The habit, or manner, is affected alike by the top-hatted-frock-coated representative, and by the overalled mechanic. *It is a bad habit.*

Another and more pleasing feature of the Exhibition is the evidence of the growing popularity of the individual electric motor drive, more particularly as applied to machine tools. Some interesting examples of this are to be seen at Stands 195 (Pollock & MacNab, Ltd.) and 201 (Cunliffe and Croom, Ltd.). At the former are shown several machines, including centre and capstan lathes, a combination turret lathe, and radial drilling machines, each individually driven by a motor made by Electromotors, Ltd., Openshaw. The lathes are driven by a single spur-gear reduction, direct from the motor, which is mounted on the headstock of the machine in a manner suggestive of forethought and not afterthought. The starting switch is fixed below the motor, and is easily operated by the machinist when changing his speed. The motors are constant speed machines, and are fitted with the ingenious brushgear which has been previously described in our columns. All the speed variation is obtained by means of change speed gear contained in a gear box or "speed variator" in the head of the machine. Sixteen spindle speeds in geometrical progression can be obtained on some of the machines, the maximum cutting speed being 260 ft. per minute. A finer speed adjustment could be obtained by a variable speed motor, but the machines were designed primarily to dispense with the cone pulley drive, and to give a wider range of speed with a single pulley than the cone pulley gives. A small amount of shunt regulation for intermediate speeds between those given by the change speed gear, might be an improvement, and would give a range of 100 or more speeds in very fine increments. It is claimed that the design gives a constant cutting power on all diameters. The machines are tested and set for their guaranteed power, and if they are overloaded a spring-loaded slipping clutch comes into operation and stops the feed.

At Cunliffe & Croom's stand an interesting feature is a 2 ft. 6 in. × 2 ft. 6 in. × 6 ft. planer. A L.D. and M. Co.'s motor is mounted on the top of the machine and coupled directly to the first-motion shaft of a four-speed gear box, from which the usual open and crossed belts are driven. The return stroke of the table is constant, the cutting stroke only being varied. Another individually driven machine is a vertical planer-type milling machine, designed for milling the aluminium castings of automobile engines and gear boxes.

There is a fine and imposing show of machine tools at the stand of Schuchardt & Schutte (120), many being individually driven by L.D. and M. Co. and Crocker-Wheeler motors. The machines exhibited include high speed lathes, automatic gear hobbing, screw cutting, vertical milling, grinding and buffing machines, &c. Several examples of the individual drive by means of silent chain may be seen at the stand of Henry Pets & Co. (141), such machines as joist shearing, double ending, notching, and croppers being among the number.

There are many other machine tool firms well represented, but the electric driving arrangements do not call for special mention.

W. H. Allen, Son & Co. (Stand 92) have a very interesting and comprehensive exhibit, including their well-known two and three-crank compound enclosed high-speed engines, Allen-Edwards air pumps, centrifugal pumps and turbine pumps, as also have

Clarke, Chapman & Co. (Stand 91), who show a variety of their manufactures ranging from small pumps to water-tube boilers, and including apparatus of such divergent character as searchlight projectors, coupled ship lighting sets, electric capstans and winches. The brushgear in the dynamos shown is fitted with a very simple and effective form of hold-off catch, and both dynamos and engines are what is commonly called a "tip-top" job. The guards over the spur gears of the motor-driven pumps, &c., struck us as being very neat and effective, contrasting very favourably with the band-box type of case so often seen.

At Stand No. 20 the Johnson-Lundell Electric Traction Co., Ltd., exhibit a range of sizes of their patented type of laminated field motors. For these motors it is claimed that

for a given output and temperature rise they occupy a smaller space than any other motor on the market. This is a valuable feature in motors which have to be geared up directly to a machine. Some buyers judge a machine, like a pig, by its size, as though they were paying merely for material, forgetting that the larger a machine is, the greater probably are its internal losses.

It is claimed, too, for these machines that as wide a speed range by shunt control is obtained without auxiliary poles or other complications as is obtained by other makers with these additions. The brush gear is interesting. Each point of commutation is provided with twin brushes, one of which collects the current, and the other, the trailer, possessing high contact resistance, effects sparkless commutation. Each brush feeds independently of the other, although both are controlled by the same bow spring. The J.-L. new design of three-phase motor is also shown, and at the same stand are to be seen various patterns of the Foster enclosed arc lamps, double carbon and magazine flame lamps.

The gas and oil engine industry is well represented, the Crossley and National Companies being well to the fore. One of the later firms to take up the gas engine business are E. S. Hindley & Sons, who, at Stand 233, exhibit besides steam engines, one of their vertical high-speed gas engines directly coupled to a 15-KW. dynamo, and running at 600 R.P.M., the engine being fed from a suction gas producer. We recently had an opportunity of seeing a test on a 50-KW. high-speed coupled gas engine set at the works of this firm, the speed being about 500 R.P.M., and were very pleased not only with the running of the plant, but with the sound engineering features embodied in the design of the engine, and also of the producer equipment itself. The construction of the scrubber is more on the lines of a cylindrical boiler than of a water tank.

Another coupled set suitable for country house lighting is exhibited by a firm from the Garden City—namely, the Heatly-Gresham Engineering Co., Letchworth. In this case, the prime mover is a high-speed oil engine directly coupled to a dynamo, and running at about 600 R.P.M. This engine is claimed to have all the advantages of the petrol engine—but without its disadvantages of construction and excessive speed—coupled with all the advantages of the ordinary oil engine. It works with ordinary paraffin, and is fitted with electric ignition, no starting lamp being required. We understand, however, that when no starting lamp is used the engine is started up on petrol, and when once started is run on paraffin. The moving parts are enclosed in a crank chamber, which is provided with large inspection doors. The lubrication, however, is not on the splash principle, the oil being lifted by means of gear wheels and conducted to the parts requiring lubrication by a system of collecting fins. This permits of liberal lubrication of every part without any fouling of the exhaust.

Passing the suction gas plant with coupled engine and dynamo exhibited by the National Gas Engine Co. (who, it is rumoured, will eventually re-unite with the company from which they originated, viz., the Crossley Gas Engine Co., exhibitors of similar apparatus at Stand 266), we come to the display (at No. 50) of Dugdill's patent movable electric fittings. Since the last Exhibition Messrs. John Dugdill & Co. have added several new designs to their system of swivel fittings, and they now show quite a large variety of patterns in which their special swivelling device is used. A metallic pendant is also shown with universal self-sustaining joints, which, it is claimed, do not unscrew or slacken. Another interesting fitting is the reel switch pendant, in which a spring reel contains a double-pole switch. By simply pulling down the lamp the current is switched on, and on raising the lamp it is switched off, both poles being disconnected. The device may be attached to either pendants or brackets.

The Walsall Hardware Manufacturing Co. exhibit at Stand No. 51 their patent grip continuity system of conduits which is well worth inspection, and almost adjacent to them the Light Electric Motor Co., Ltd., Stand 54, show some very useful applications of small motors. Their portable drilling machine is a very compact piece of apparatus, and it is claimed that owing to the special construction of the motors, no overload cut-out is necessary, as, should the drill stop dead in cutting through a hole, no immediate burning out of the motor can take place. The equipment is provided with a tumbler switch placed in a convenient position for the operator, and a length of flexible cord terminating in an adaptor plug which will fit into an ordinary lamp-holder.

The electric motor hair brush exhibited by this firm calls for special mention. The motor itself is enclosed inside the cylindrical frame of the brush, in which no wood or other absorbent material is used. A tumbler switch fitted on one of the handles affords an easy method of starting and stopping. At the end of one of the handles is an adaptor plug for fitting into a holder, and the usual practice is to have a few counterbalanced flexible pendants without lamps above the operating chairs, which can be pulled down and attached directly on to the brush. The brushes are kept in position by a spring fastening, and one motor may be used with several interchangeable brushes. The makers give several illustrations of the brushes in actual use, although the unruffled state of the victims' hair rather gives the photographs away.

A large array of portable drilling machines are also shown at the Stand No. 57 of S. Wolf & Co. Their "featherweight" electric drill, including motor, weighs only 8 to 10 lb. This is used for boring small holes, such as for fixing name-plates, centring shafts, lubricating holes and the like.

At the Consolidated Machine Tool Co.'s exhibit, Stand 119, may be seen both pneumatic and electric tools, together with a motor-driven air compressor. One of the features of the electric drills of this company is the magnetic holding-on device by means of which fixing bolts may be dispensed with. For high-speed work double and triple armature machines are used with the object of keeping down the peripheral speed of the armature. By this means drills are run up to speeds of upwards of 5,000 R.P.M. The subdivision of the armatures also permits of a very compact arrangement and assists considerably in air cooling, a continual circulation of air being kept up inside the motor case. At this stand also is exhibited one of the best tube scaling tools we have seen. The machine exhibited is operated by means of compressed air, which serves a double purpose, namely, of operating the tool, and also blowing the dust and scale through the tube, the latter function being accomplished by the exhaust from the tool itself. A series of small cutters are fixed into a circular block so that the outside diameter over the cutters corresponds with the inside diameter of the tube to be scaled. The cutting edges are arranged to strike directly on the scale by a hammer action, and the tool is rotated backwards and forwards through a small angle by hand whilst in operation. We saw the apparatus at work, and also saw some tubes which have been partly scaled. Some of these were economiser tubes of about 3½ in. or 4 in. diameter, in which there was a scale of fully ¾ in. thick. It is obvious that the only function of such an economiser was to throw extra work on the feed pumps, and that it was absolutely useless as a feed water heater. We also saw samples of tubes taken from a water tube boiler which had been scaled by this tool. The scaling was so bad that it was proposed to throw the boilers out entirely, but the tubes have now been entirely cleared by the Ratcliffe tube scaling tool.

An exhibit that will be of interest to central station engineers is that of Sanders, Rehders & Co., Stand 121. Here, in addition to the well known Sarco CO_2 recorders, a recording steam meter is shown, by means of which the amount of steam passing through a steam main is indicated either on a dial or on a recording drum. The recorder depends for its operation upon a slight drop in pressure between the two sides of a disk which is fixed between two of the flanges in the pipe line. The disk has a bore slightly smaller than the diameter of the pipe, which tends to throttle the steam slightly. There is a slight drop of pressure behind the throttle, the difference of pressure on the two sides bearing a certain relationship to the quantity of steam passing, according to the well-known Zeuner-Napier formulas. The dials or recorder charts are marked to show the rate at which steam is passing.

Other items of interest to electrical engineers will be found in the exhibit of the Fairbanks Co., who at Stand 143, near the main entrance, show several patterns of the Yale and Towne electric hoists; also at the British Insulated

and Helsby Cables exhibit, where the Prescot welder is shown; also at the Mordey-Fricker Electricity Co.'s Stand No. 226, at which the latest patterns of this company's electrolytic prepayment meter and maximum demand indicators may be seen, and the very ingenious electric punkah shown by Bergtheil & Young is also, we think, deserving of notice.

THE MUNICIPAL TRAMWAYS CONVENTION.

In the following pages we briefly record the doings of the Municipal Tramways Association at their sixth annual conference, which was held in the Manchester Town Hall last week.

Welcomed with enthusiasm by the civic authorities of the twin cities of Manchester and Salford, and having a full programme, with unusually fine weather, the three days' proceedings were very successful in every way.

The business of the first day commenced with the presidential address by Mr. J. M. McElroy, general manager of the Manchester Corporation Tramways, which resolved itself into a defence of the principle of municipalisation of tramways, and was naturally warmly applauded by those present.

Following were papers by Mr. R. L. Acland (Chesterfield), who dealt with the tendency which exists at the present time to adopt long wheel-base trucks, flexible or otherwise, with a view to counteracting the oscillations of the much over-hung single truck cars of the present day, and by Mr. A. Baker (Birmingham), who demonstrated the improving conditions as regards hours of labour and pay of tramways employés at the present time. Subsequently the members were entertained to luncheon by the Manchester Tramways Committee, the afternoon being devoted to an inspection of Manchester's efforts at car-building and repairing, and of the Stuart Street generating plant; and the evening to a reception, held in the Town Hall.

The second day's proceedings included, in the morning, the business meeting of the Association, a prolonged discussion on Mr. Baker's statistical paper of the preceding day, and a paper by Mr. J. Dalrymple (of Glasgow) on "Staff Organisation."

Possibly with a view to being in keeping with the medieval character of Manchester's Town Hall, the two former meetings partook of the character of the secret conclave, and thus we were only able to gather that Mr. J. Aldworth, general manager of the Nottingham Corporation Tramways, was elected to the President's chair for the coming year, with Mr. A. L. C. Fell (L.C.C. Tramways) as vice-president, and to wend our way towards the sumptuous luncheon provided by the civic authorities of Salford at the Pendleton Town Hall, with a suspicion that a skeleton, possibly in the shape of a Labour representative, had appropriately appeared in the secret chamber when Mr. Baker's labour statistics came up for discussion.

However, the mysterious proceedings of the morning were forgotten in the sunshine of Buile Hill Park, where afternoon tea was provided by the Salford Corporation, and later, in the evening, in the glare of Manchester's White City, where we were entertained by the Anglo-Americanisms of Mr. Calvin Brown, managing director of that hive of amusements, delivered point blank after a "bully" dinner, partaken of at his invitation.

With the last day's proceedings came a discussion of Mr. Dalrymple's paper, read on the previous day, also a somewhat unconvincing paper on the vexed question of rail corrugation, by Mr. A. L. C. Fell (London).

As regards the former, interest centred round the question of who could best control permanent way repairs and tramway finance, and the discussion disclosed the possibility of a very satisfactory compromise being effected by which the tramways department, even though it did not actually do the work, obtained full control of these matters.

Mr. Fell's paper and its discussion did not add much to our already over-full store of knowledge as to the why and wherefore of corrugation, although it perhaps tended to confirm previous convictions that with the rails rather than the cars rested most of the blame in the matter.

The conclusion of this discussion, and the tendering of thanks to all concerned, terminated the business of the Conference, which appropriately wound up with a lengthy, though pleasant, tramway and 'bus excursion to Tatton Park in the afternoon, and was followed by tea, provided by the Manchester Tramways Committee, at the Royal George Hotel, Knutsford.

The Conference was one of the largest so far held; the business interesting, with an added spice of mystery; and the entertainment most enjoyable.

The sixth annual Conference was opened at the Town Hall, Manchester, on Wednesday last week, and continued on the two following days. The presidential address was delivered by Mr. J. M. McElroy, general manager of the Manchester Corporation tramways.

The President congratulated the members on the Association's continued prosperity and usefulness; its membership included representatives of practically all the municipal tramway authorities in the kingdom, whose combined undertakings represented a total capital outlay of something like 40 millions sterling.

The necessity for the existence of such an Association was felt long before it came into existence, and he thought that no Association had ever proved of greater value to its members, or displayed greater vigilance in looking after the general interests of the various authorities it claimed to represent.

They had still, from time to time, to face strong criticism from certain quarters—not all of which was disinterested.

Practically all the writers on the subject of municipal trading had failed to present their case with freedom from bias. As an instance of this he submitted the following extract from a recent publication on "The Dangers of Municipal Trading":—

"Such trading with the public credit, whether State or Municipal, must of necessity lead to stupendous financial liabilities, add to the burden of the rates, weaken municipal credit, bring about inequality of taxation, interfere with the natural laws of trade, check industrial and scientific progress, stop invention, discourage individual effort, destroy foreign trade, establish an army of officials, breed corruption, create an aristocracy of labour, demoralise the voter, and ultimately make Socialistic communities of towns and cities."

They could show in some of the large cities concrete examples of "Municipal Trading" in the shape of well-equipped up-to-date tramway systems, providing excellent means of transit at cheap fares, paying over large sums of money in relief of the rates, and at the same time maintaining the undertakings in sound financial condition by making adequate provision for depreciation and renewals, and, in addition to that, paying off the borrowed moneys by means of the sinking funds, so that the next generation would have handed over to them fully-equipped tramway systems, efficiently maintained, and entirely free from debt.

On the other hand, it might perhaps with some justice be contended that the advocates of "Municipal Enterprise" had failed to a large extent to meet many of the objections raised by their opponents, or even to admit that there were difficulties and dangers, inseparable from municipal operation even under the best conditions prevailing to-day.

The Tramways Act of 1870, which authorised the construction of tramways, had been pointed to by the anti-municipal traders as an Act which, perhaps more than any other, had the effect of "strangling" an industry which it was the aim of its framers simply to regulate and control. They had stated that it "destroyed private initiative" and "paralysed" the tramway industry in this country.

The celebrated forty-third section of the Tramways Act—the *crippling* section—which enabled local authorities to purchase from private companies at the end of 21 years, provided that the price was to be "the then value of the tramway (exclusive of any allowance from past or future profits of the undertaking, or any compensation for compulsory sale, or other consideration whatsoever)." The words were proposed in order to put it beyond doubt that goodwill was to be excluded from the valuation.

It was the limited period of this concession—21 years—added to what had been incorrectly described as the "scrap-iron" purchase price, which the anti-municipal traders pointed to as having the effect of "strangling" the tramway industry, and in illustration of this they pointed out that for many years, particularly during the last years of the companies' *régime*, tramway enterprise was practically at a standstill in this country, and our tram travelling public were compelled to put up with horse or steam haulage, with rolling stock, track and equipment generally in a moribund state, whilst in American and Continental cities the public were enjoying the improved means of transit which resulted from the introduction of electric traction.

No doubt these contentions were to some extent true, but the municipal advocates would point out that it was better to forego immediate benefits, and to put up for the time being with the slower and less convenient means of transit, if the effect of such action or inaction on their part resulted in ultimate municipal ownership of the undertakings and the development of the same along such lines as would best meet the requirements of the public and the interests of the ratepayers.

That local authorities had in a number of instances prevented tramway development by exercising their veto under the Standing Orders, and that they had imposed onerous conditions on tramway promoters before giving their consent, was undeniable. In recent

years the effect of this Standing Order had been felt by some of the larger municipalities themselves. Their tramway systems were now spreading into the suburban districts, and the refusal of the local authorities to give their consent for the construction of new lines—except, perhaps, under conditions financially impossible—was apt to be a serious barrier to tramway development, and might retard progress by preventing the spreading of the population from the central to the suburban districts, and the relieving of the congested city areas.

They had a very important lesson yet to learn from America in the energetic manner in which the tramways were extended into districts absolutely unbuilt upon. There the tramway *preceded* the population. This was a lesson which the municipalities of this country would do well to bear in mind.

The constant pressure from the public for greater concessions was an undoubted source of danger. In the tramway business the margin of profit per passenger was so small that any ill-considered scheme involving reduction of fares was likely to turn a handsome profit into a huge loss.

Then, again, the anti-municipal trader pointed to the danger of the large and increasing number of municipal employés, and the political influences which might possibly affect the engaging and control of such employés, and the consequent risk of slack and inefficient service to the public.

Another danger, and a very serious one, in connection with municipal trading concerns was the strong tendency when the rates were high and on the increase, for members of corporations to look to the trading departments for relief in the shape of increased amounts to be handed over in aid of the rates.

In the case of tramways, instances could no doubt be found where "profits" had been paid over in relief of rates which ought to have been retained by the undertakings if proper regard had been had for their financial stability. The question of depreciation was one which should be seriously faced by the municipalities. If the loan period synchronised with the "life" of the asset, especially the track, there would be little to say against the sinking fund being regarded as proper provision for depreciation; but the track would be worn out long before the loan was repaid, and this was, therefore, a matter calling for serious attention on the part of the municipalities.

The American Commission which visited this country last year to investigate and report upon the question of municipal ownership had recently published its report.

In so far as tramways were concerned, they gave a distinct verdict in favour of the principle of municipal ownership.

They held that no municipal operation was likely to be highly successful that did not provide for:—

"1. An executive manager with full responsibility, holding his position during good behaviour.

"2. Exclusion of political influence and personal favouritism from the management of the undertaking."

The success of any undertaking, municipal or private, depended upon the men placed in command. Given public men with high ideals of municipal government, with broad and comprehensive views, with business experience—given well-trained public-spirited officials, men of integrity, tact and good judgment—the municipal movement in this country would continue its prosperous career, and would justify the conclusions long ago arrived at, namely, that all those undertakings which were in the nature of necessities, monopolies, and required the use of the public streets, should be owned and operated by the municipalities in the interests of the ratepayers and the public generally.

Long Wheel-Base Trucks.

By R. L. Acland, M.I.E.E., Tramways Manager, Chesterfield Corporation Tramways.

(*Abstract.*)

The long wheel-base single truck, in the opinion of the author, is superior to either of the older types, and he considers that before long it will be very much more largely adopted in this country. In Nuremburg, Vienna, and Buda-Pesth, cars with wheel-centres varying from 8 ft. 2 in. to 11 ft. 10 in. are being used.

The standard single-truck double-deck car as used in this country carrying from 50 to 56 passengers, with an efficient stairway to the top deck, not the "Reverse" staircase, and with a top deck cover, is an ideal car for all weathers.

From the engineering point of view, however, to run a self-propelled vehicle weighing about 12 tons, spread over a length of some 30 ft. on a wheel-base not exceeding 6 ft. 6 in., at speeds up to 16 miles per hour, is certainly contrary to what has been found to give the best results on other forms of rolling stock.

The bogie car is, in the author's opinion, only suitable for inter-urban transit, or in large towns where both types of car are used, when they are useful for loading up at crush hours with the long-distance or "through" passengers, but to continually stop and start a car carrying between 80 and 90 passengers for the accommodation of general traffic is certainly not heading towards the greatest economy. A further result of discrimination in car functions on a large system as outlined above, is that the comfort of the passenger and loading speed capacity, will be in proportion to the length of the journey.

From an engineering point of view, the bogie car is a considerable improvement on the single-truck type.

In 1904 when advising the Corporation as to the type of truck to adopt on the Chesterfield tramways, the author wanted the standard two-deck body mounted on a single truck with a long wheel-base, and recommended the adoption of the only one at that time on the market.

The result of nearly three years' working with this type of truck has clearly demonstrated that a car mounted on a long wheel-base gives the most comfortable riding owing to the great reduction of pitching and side oscillation; the body is also supported practically throughout its length, and can in consequence be of lighter construction, the strain on body, truck and track, when running through points or round curves, is largely reduced; no case of derailment has occurred on this system unless through an obstruction on the track, and not a single axle has been broken.

The long wheel-base trucks mostly in use in this country are called "Radial" trucks; a better name would be "Flexible" trucks, because they do not radiate, in the geometrical sense of the word, and the author considers that in designing these, the necessity for a minimum amount of flange friction on short radius curves, has been made too much of, with the result that the trucks have been rendered unsuitable for high speed on a straight track.

On all these cars the tractive force is applied at the centre of the truck frame through king pins, which are fixed only a short distance to the front and rear of the diagonal centre of same, instead of at the axles; the inner trucks carrying the motors and brake gear, together with the axles, are free to move about these pins as centres, subject to the controlling effect of springs or inclined planes, the result of which is that any end oscillation of the body and main frame, or tendency of the trailing motor to do more work than the leading motor, will move the king pins off the central line of the track and put both axles out of square with the rails, in which position they will often remain with disastrous results to the tire flanges. To get over this latter trouble a link suspension with gravity control has been recently put on the market, and is being tried on several lines, which certainly seems to fulfil its claims in this respect; but with such a delicate method of hanging the car-body, the axles are more likely to be constantly slightly deflected, with the result that while the flange wear may be reduced, the constant grinding slip on the rail-head will be increased.

Experiments are also being made with locking the inner trucks completely, and thus using an 8 ft. 6 in. rigid wheel base. On one line having curves of 40 ft. radius, cars with chilled wheels have been running successfully for some time with much better results in the way of wheel flange wear, than when the axles were free to move, and, it is stated, without any appreciable increase of wear of the check rail on curves. The author is also experimenting in the same direction at Chesterfield, using a special V-shaped flange on the wheels, and is inclined to think that this will be the ultimate form of the long wheel-base truck, with wheel-centres spaced from 8 ft. 6 in. to 10 ft.

One of the fallacies that has grown and flourished in the past, was that tramway trucks could only be built in America; we can turn out some of the finest locomotives and rolling stock in the world, so that surely we are capable of building a good tramway truck, and more of the leading firms would give this all-important matter their attention, provided tramway authorities were prepared to pay a reasonable price for a good article.

One of the chief results of investigation will be, in the author's opinion, a greatly extended use of the long wheel-base truck.

Mr. R. C. Bullough (Colchester), who opened the discussion, could not agree that a long wheel-base truck would travel round a curve better than a short one, although it would, of course, give smoother running on the straight.

Mr. P. Fisher (Dundee) asked how the author came to the conclusion that steel tired wheels produced more corrugations than chilled iron wheels.

Mr. H. Mozley (Burnley) referred to experiments being made in his town with a new design of car, 37 ft. 10 in. long, with an 18 ft. wheel base and two-motor equipment. The car body is supported on two single-axle trucks; the latter have centre pins and carry the body on roller paths. The axles are fitted with differential gear with a view to allowing independent motion of the wheels when rounding curves, and it is claimed that a very flexible truck with a wide range of angular movement is obtained. Full details of the design were not disclosed owing to the experiments being incomplete.

Ald. Smith (Liverpool) upheld the virtues of the reversed stairway, which was in use on practically all the Liverpool cars, and added that his city was experimenting with trucks having a 7 ft. to 7 ft. 6 in. wheel base.

Mr. C. W. Hill (Birmingham) referring to his experience on the Birmingham Corporation tramways, where 150 radial truck cars were in use, said that trouble had been experienced through the axles setting themselves askew, but by increasing the flexibility of the trucks this was remedied. He considered that rail grooves on curves would have to be widened, and that users of radial trucks must be prepared for increased wear and tear on flanges and rails. The comparative cost of maintenance of the types of truck in use in Birmingham were:—20 maximum traction trucks, £5 6s. per car; 150 radial trucks, £1 16s. per car; and 100 rigid 6 ft. w.b. trucks, 17s. per car. The bogie cars had been in use for some 3½ years, but the other types were only introduced during the present year, and it was, of course, impossible to say what the increased maintenance would be in a few years. The costs given did not include wheel renewals, but the average life of the steel tires was 20,000 miles. He considered that the long wheel-base truck was successful in Birmingham, where the gauge was only 3 ft. 6 in., and the running of the long top-cover cars was free from oscillation.

Mr. J. Dalrymple (Glasgow) inquired whether Mr. Acland had heard, while in Nuremburg, that nearly all their tracks required

renewal in a few years, through using long wheel-base trucks. He considered that increased track renewal was too high a price to pay for the advantages of a long wheel-base.

Mr. Moffet (Rochdale) remarked that his experience of radial trucks (since 1904) led him to the conclusion that they did not radiate, although they were certainly flexible. He expressed his belief in the efficiency of the long single-deck bogie car, and pointed out that top covers did not encourage the fresh-air passenger. Wheel tires on radial trucks had a life of 20,000 to 30,000 miles, as compared with 50,000 to 60,000 miles on small rigid trucks.

Mr. Acland, in replying, said that his plea was for longer wheel-base, whether flexible or rigid remained to be decided. He created some amusement by hinting that a truck of similar design to Mr. Mozley's had been responsible for the trouble at Nuremburg, and suggested that the increased wear on curves by long wheel-base trucks would be more than compensated for by their improved running on the straight. The life of the steel tires on his radial truck cars in Chesterfield was some 46,000 to 50,000 miles.

Rail Corrugation.

By A. L. C. Fell, M.I.E.E., M.I.Mech.E., Chief Officer, London County Council Tramways.

(*Abstract.*)

In May, 1905, the author visited America, and on his return presented a report to the London County Council, in which he made a few remarks on the subject of rail corrugation. The following is an extract from this report:—

"In every city I visited in America, except Buffalo, corrugation is to be found in a more or less marked degree. Apparently the higher the speed the greater the length of the corrugation wave. On several of the interurban lines the cars are run at speeds of from 20 to 30 miles per hour, and the corrugation in some instances was as much as 8 in. long.

"On the Boston elevated railway, where the cars are run at upwards of 40 miles per hour, the corrugation was no less than 31 in. long. The trouble on this line is so serious that the rails have to be renewed every few months.

"Before going to America I had for a considerable time been engaged in investigating this matter, and formed the theory that the trouble was originally caused by unevenness on the rail surface setting up a slight jumping or bounding action in the car wheels.

"I consider that the unevenness might be due to three causes:—

"1. Chattering or vibration of the rollers when commencing to roll the ingot into a rail, causing a rough rail surface.

2. Uneven or wide joints between rail ends, rigidly supported on a concrete bed.

3. Jumping action set up in car wheels by variations of the wheel or track gauge.

"To ascertain if my first theory was correct, I made some tests in the New Cross car-shed before the rails had been used in any way by the cars. A long emery block, fitted under a truck, was lightly run over several lengths of track, and a distinct corrugation was noticeable on the rail surface, although in some instances it was not very regular in form.

"About nine months ago I had a water-tank car fitted up with a grinding apparatus, consisting of a carborundum block, 10 in. long × 2½ in. wide, which could be pressed down on to the running rails. By this means some of the worst corrugations were ground out, and have not yet reappeared."

After further study and investigation on various tramway systems, the author has come to the conclusion that corrugations are not due entirely to one cause. The following are, in his opinion, some of the chief producers of the trouble:—

1. Original roughness of rail after rolling.
2. Cold rolling of rails by the car wheels.
3. Soft rails and heavy cars.
4. Sand and grit on head of rail.
5. Defective and open joints.
6. Tight or wide gauge of track or wheels.
7. Loose or springy rails and points.
8. Defective trucks being out of square and buckling.
9. Slip of wheels at curves.
10. Wheels not being same diameter.
11. Flats on wheels.
12. Rapid acceleration and retardation, causing wheels to slip.
13. Defective brake mechanism, or by a too rapid application of the brakes causing chattering and a series of short skids.

These and many matters may be responsible for the trouble, but the author still considers that the "original sin" is produced when the rails are rolled and will quickly develop into corrugation unless the surface of the rails is ground immediately after they are laid.

On the Vauxhall to Victoria route the rails were rubbed with carborundum blocks before electric cars began to run. Distinct signs of corrugation then appeared, and were ground out. A heavy service of cars has been in operation over these lines during the past 14 months, and there are only very slight signs of corrugation, except on the Vauxhall Bridge crossing the Thames where the corrugation is more serious. This is, no doubt, due to the spring of the rails on the bridge. In another case where fully developed corrugations along the Clapham Road were rubbed out in a similar manner at the same time, the rails are now badly marked again, the service of cars and the speed in each case being practically the same. Generally speaking, the outer rails of the curves are most deeply marked, and the pitch of the corrugations is fairly regular, the average being 2 in. The inner rails of curves are usually marked in irregular patches. On straight tracks, however, the corrugations are not so irregular.

On inclines the corrugations are deeper and more regular on the up than on the down grade. As a rule, corrugations do not appear on down grades where track brakes are regularly used as service brakes.

In places where the rails are not anchored the corrugation is much worse than on lines where the rails are anchored or laid on extended yokes.

Very few cases are known of corrugated rails on horse and steam tramways, but the author saw an interesting case a few weeks ago in one of the London Docks where the rails carrying a large steam-driven jib crane were badly corrugated, the corrugations being about 2 in. long, and extending nearly the whole length of the rail.

With very few exceptions the check rails are not corrugated on the London tramways. Corrugations have appeared on some of the rails in London after they have been in use for a few days, but on most of the rails they have appeared in about six months.

The author does not agree that corrugations generally are caused by defective trucks, although this may, under certain conditions, be responsible for corrugations. This statement is based on the following fact:—When ordering additional rolling stock about two years ago, the author came to the conclusion that the ordinary stock trucks on the market were unsuitable for heavy service. He, therefore, in conjunction with eminent truck manufacturers, set to work to design a truck that would meet the requirements, and be a thoroughly sound mechanical job. This was done, and the results have been very satisfactory. Some of these trucks were put into service on the Aldwych Subway line, and similar trucks were put into service on the Poplar line.

On the Subway line, where the rails are laid on longitudinal sleepers, corrugations were noticed a few days after the line was opened. These were ground out, but appeared again after a few months' working, and it was anticipated that the trouble would become serious; but for the past three months there has been practically no change, if anything the corrugations are somewhat less marked. On this line the steel cars are fitted with magnetic track brakes and sand-boxes of the intermittent flow type. On the Poplar route, which has been running with a heavy service of cars for upwards of 12 months, no corrugations have yet appeared. In this case the rails are mounted on extended yokes and are anchored.

The author thinks the chief cause of corrugation on the Subway lines is the fact that the rails are on a springy bed, and the cars run at speeds up to 20 miles per hour.

On the Poplar route the cars cannot be run at a very high speed owing to the heavy vehicular traffic. The cars on this route are fitted with magnetic track brakes, and sand-boxes of the continuous flow type.

The wave form of corrugations is generally the same and the marking is usually not at right angles to the head of the rail.

The author has noticed that the corrugations on the inner rail become longer as the curve becomes sharper. This is, no doubt, accounted for by the additional slip on the inner wheels.

Some years ago when inspecting the Hamburg tramways, it was noticed that the groove of the outer rail of each curve was partly filled up, so that the outer wheels would run on their flanges, thus increasing their running diameter and reducing the "marking-time action" on the inner wheels to a minimum. The writer believes that this method of construction would reduce corrugations at curves.

It has also been noted that apparently with very high speeds the corrugation wave is longer, but in the author's opinion it is not altogether the high speed which causes the long corrugation. Most probably the heavier cars used, when running (as in America) at speeds up to 50 miles per hour, are responsible for the longer waves.

On tramways where magnetic track brakes are used constantly as service brakes, corrugation has not appeared to any appreciable extent. Several routes in London have been running for nearly 12 months under these conditions. If this state of affairs continues, it will support the theory that corrugations may sometimes be caused by the application of the wheel brake, but experience generally shows that corrugations may appear at any time, and in the majority of cases the trouble does not become serious until after about two years' service; this, of course, depends on the service of cars run on each particular tramway.

An important question, which has to be answered before the root of the evil can be discovered, is "Why are corrugation waves the same length with varying speeds within certain limits, say, from 4 to 16 miles per hour?"

One possible explanation is that corrugation may be in some instances caused by the cold rolling of the rail by the car wheels. With a light car, such as a horse car, the rolling is almost imperceptible. With a heavier electric car the weight is sufficient to start cold rolling, and a wave starts at the softest part of the rail and travels forward until the weight of the car is not sufficient to carry the wave further; the wheels then ride over the top of the wave and violent oscillation is set up, and the corrugation gradually extends. This theory will possibly partly account for the non-appearance of corrugations on heavy railways. In this case the weight of the train would be sufficient to roll the rail throughout its whole length, especially as the whole of the wheels under the carriages are simply acting as rollers.

Numerous instances can be given of corrugation appearing on manganese and cast-steel special work. In most of these instances the corrugation has appeared on the rail butting up to the special work or on a movable point tongue, the corrugation gradually extending to the fixed casting.

A peculiar instance of corrugation was observed by the author in St. George's Road, in London, where there are patches of corrugation 18 in. long and 9 in. apart extending throughout the length of one 45-ft. rail. The centres of the corrugations are 3 in. apart. It has been suggested by many engineers that corrugations most frequently appear at stopping places. This has not been the experience in London.

The fact that corrugation has appeared on cable tramways with light cars rather opposes the theory of cold rail rolling, but this is a subject which should be dealt with separately. One fact, however, might be mentioned, viz., that on the Birmingham tramways some years ago corrugation appeared on one of the two systems then in operation. On one system the cars were, I believe, run at a speed of 8 miles per hour, and on the other, at 6 miles per hour. On the higher speed line the corrugation was serious, but on the slow-speed line no corrugations appeared. Corrugation also appeared on the Streatham Hill line in London, where the cars were run at a speed of 8 miles per hour. This supports the theory that speed in some degree is responsible for corrugation. No doubt in this instance it was caused by the vibration transmitted by the cable at the particular speed of 8 miles per hour.

To reduce the trouble to a minimum, the following suggestions will, in the author's opinion, be found beneficial:—

TRACK.

1. The rail should be anchored down at intervals of not less than 7 ft. 6 in.
2. A hard wood packing block $\frac{3}{4}$ in. thick should be placed between the anchor and the rail flange.
3. All joints should be close butted and carefully filed. Possibly it would be an additional safeguard if the rail joints were welded.
4. A water car fitted with carborundum grinding blocks should be run over the line to remove all irregularities before the cars commence running. This will be found a simple, quick, and inexpensive process if carried out immediately after the track is constructed, and the development of corrugations will be deferred for a considerable time.
5. Immediately the slightest sign of corrugation appears to grind the rails, as suggested above.
6. By partly filling up groove of outer rail so that outer wheels run on flanges at sharp curves.

ROLLING STOCK.

1. Secure first-class trucks of good mechanical design, which will not buckle or get out of square at sharp curves.
2. See that the trucks are absolutely square.
3. The diameter of the wheels should be kept equal as nearly as possible.
4. By separately driving each wheel or by introducing deferential gear, as in the case of a motor-car.
5. By using continuous-flow sand-boxes.
6. By using magnetic track brakes as service brakes.

The discussion on this paper was opened by Alderman DURNSFORD (Southampton), who referred to the rapid appearance of corrugation on the Southampton system after relaying with heavy rails.

Mr. A. A. BLACKBURN (Belfast) pointed out that corrugations did not appear on the Liverpool Overhead Railway until after the adoption of geared drives on the motor coaches, from which he inferred that the end drive might be responsible for the trouble, and that the latter would disappear if double-ended gear drives were generally adopted. A general overhaul of the trucks and horn blocks on the Belfast cars had improved the running conditions in that city.

MR. H. E. YERBURY (Sheffield) agreed with the author that cold rolling and oscillation were largely responsible for corrugations, but as the latter appeared in new rails he did not consider that sanding was a cause. In Sheffield corrugations had appeared on track laid on sleepers, and on both anchored and unanchored track, also on trolley wires, particularly over track junctions and crossings. While he agreed that the drive was a point to be considered, much more depended on the construction of the truck.

MR. H. MOZLEY (Burnley) said that he had found corrugations equally on routes where track and wheel brakes were employed. The cost of rubbing corrugations out on his system was 1·80d. per yard.

MR. C. J. SPENCER (Bradford) pointed out that though the conditions existing in his city were generally the same as in other towns with heavy services, yet corrugations had only appeared on one small length of track which was on made ground.

MR. STEPHEN SELLON considered that the corrugation question rested with the rails, instancing the fact that Belgian rails, rolled to his own specification as to composition and containing high carbon contents, had not corrugated, although adjoining track laid with English rails, and worked under the same conditions, had done so. Tramway managers should specify the composition of their rails and see that they obtained a high-carbon rail.

MR. ARTHUR ELLIS (Cardiff) pointed out that corrugations had appeared on several steam-operated railways in England and Wales.

MR. R. H. WILKINSON (Huddersfield), MR. F. HARDING (Derby), and MR. J. B. HAMILTON (Leeds), also took part in the discussion.

MR. FELL, in replying, agreed that a more rigid rail specification was required; he was getting some high-carbon rails for use on the L.C.C. system, but could not agree that the rails were responsible for the whole trouble. He further mentioned that a traverser with which he had produced corrugation, was fitted with a double-ended drive, and, therefore, the adoption of such a drive would hardly lead to any benefit.

In addition to the above, papers were read by Mr. Alfred Bak e (Birmingham) on "Hours of Labour and Rates of Pay," and by Mr Jas. Dalrymple (Glasgow) on "Staff Organisation."

Mr. Baker submitted a comprehensive schedule showing the pay, working hours, &c., of the employés of various tramway undertakings, and pointed out the continual increase in wages in recent years. As he says, although motormen and conductors cannot be classed with skilled artisans usually serving an apprenticeship to their work, yet the conditions of motormen's employment sometimes compare favourably with the conditions of the skilled artisan. He concluded by urging caution in the future in regard to concessions which would entail further expenditure.

The paper was discussed at some length *in camera*.

MR. DALRYMPLE'S paper outlined what he considered to be the ideal staff organisation for a tramway undertaking. He pointed out that it was impossible to outline a scheme which would apply to all cases, but contended that no matter how large or how small an undertaking might be, the tramways manager should have full control, not only of the revenue-earning staff, but also of all expenditure, and should have every facility for keeping himself in touch with all branches of expenditure, although the actual work might, in some instances, not be carried out by his own staff.

The discussion which followed resulted in a division of opinion as to the advisability or otherwise of the tramway department carrying out its own track renewals and extensions, and its own accounting. It was pointed out that at Newcastle-on-Tyne, after various arrangements had been tried, they had reverted to a scheme by which the city surveyor carried out tramway work, but under orders from, and with a special staff paid by, the Tramways Committee. On the other hand, it was urged that a complete organisation, such as was outlined by Mr. Dalrymple, enabled emergency work to be undertaken at the shortest notice, and this saved unnecessary delay in case of breakdown, which would occur were the surveyor's department to provide the men and plant.

The discussion terminated by MR. DALRYMPLE emphasising the necessity of the tramways department having full control of its own business, even though other departments of the Corporation might assist in the work.

LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names may be made. Answers are furnished by a barrister-at-law.*]

"B.B.B." writes:—"I shall be glad if you will kindly give me your opinion on the following:—If a municipal supply undertaking is supplying current to a building taking a very large supply, and, in addition to this ordinary supply, the consumer connects up a large quantity of temporary illuminations, which are only used, say, 15 times in the year, and these illuminations reduce the voltage of every other consumer on that district below the B. of T. limit of variation, can the owners of the building force the supply department to put in a distributor large enough to meet this occasional demand, or is it at the discretion of the department to allow these illuminations to be used?"

*** If the consumer has specified the number of lamps which he is going to use on his premises, it would seem that the supply company must be prepared at any moment to supply those lamps with power to the full extent. It is provided, however, by Sec. 18 of the Electric Lighting Act, 1882, that "No . . . person shall . . . use any form of lamp or burner . . . or use the electricity supplied . . . for any purposes or deal with it in any manner so as to unduly or improperly interfere with the supply of electricity . . . to any other person." It is possible that this clause may afford protection to "B.B.B.," who should see his solicitor.

Steel Rail Specifications.—In the last issue of the *Proceedings* of the American Society of Civil Engineers is given the report of the meeting held on July 9th, when a progress report of the Special Committee on Rail Sections was read. Specifications were submitted for the manufacture and composition of steel rails, and it is interesting to note that the Committee recommends a high carbon content, the specification for Bessemer steel rails of 90 to 100 lb. per yard being as follows:—

Carbon, per cent.	0·55 to 0·65
Phosphorus, per cent., not exceeding	0·085
Silicon " " "	0·20
Sulphur " " "	0·075
Manganese "	0·80 to 1·05

It is also specified that the temperature of the rail on leaving the rolls shall not exceed a certain limit. For basic open-hearth rails of 90 to 100 lb., the chemical composition is to be:—

Carbon, per cent.	0·65 to 0·75
Phosphorus, per cent., not exceeding	0·05
Silicon " " "	0·20
Sulphur " " "	0·06
Manganese "	0·80 to 1·05

The specifications will be considered at the annual meeting of the society.

THE YORKSHIRE BOILER.

We have received from Mr. Casmey, of Wakefield, a description of a modified form of Lancashire boiler which he terms the Yorkshire boiler. For a diameter of 8 ft. 6 in. the first boiler made has a length of 20 ft., but 25 ft. is said to be a better length. When burning 20 lb. of coal per sq. ft. of grate surface per hour the terminal temperature of the gases is only 610° F., which is claimed to be 100° lower than the temperature of the gases from a Lancashire boiler 30 ft. in length. The sole apparent difference in the new boiler is that the iron flues expand in sectional area by as much as 33 per cent. above the area of the furnace ends. The inventor claims better combustion and better heat absorption owing to the reduced velocity of the gases, but we might suggest that the boiler under observation is probably new and is showing its best results, being clean. It is, however, claimed that a boiler 20 ft. × 8 ft. 6 in. will evaporate 14,500 lb. water per hour, and this is a very high figure.

The notion of expanding flue areas is not new. It has been tried before, and great claims have been made for it, but we are somewhat sceptical as to any real benefit having been derived from the arrangement.

The information afforded us is too meagre to allow any trustworthy opinion to be formed, for there is no meaning in the bald statement that 10·4 lb. of water are evaporated per pound of fuel without reference to the feed temperature or to the pressure of evaporation.

The test figures presented are also quite unsupported, and so far we see nothing to show whether any real advantage has been secured by the method of construction that has been followed, nor do we think that there can be much practical advantage if the furnace diameter is reduced.

The grate surface of an 8½-ft. diameter boiler is given as only 36½ ft., and this appears small if the grates are of usual length. The boiler is in operation in Bradford at the works of Messrs. Ickringill & Co., but it has only worked for two months, and must be clean as yet. We see no point in the claim that the bulk of the water in a boiler should be near the furnaces, nor do we see much reason to expect that the boiler will be productive of less than the usual amount of smoke from this general class of boiler.

Still, we are open to conviction if we can see reasonable test figures properly secured. We have no objection to the Yorkshire boiler in itself, apart from what seems to us to be the probably smaller furnace diameter, for there appears very little to choose between any of the very many boilers in the world on the score of efficiency. No serious or master improvement can to-day be expected from any boiler in view of the fact that boilers have shown an ordinary efficiency as high as 80 per cent. With this fact before us, the presentation of any fresh design does not raise much expectation of better performance. A new design of boiler may do something in respect of providing a larger grate area per sq. ft. of boiler room floor, or it may provide special convenience for the housing of a superheater in gases of the best temperature, or its arrangement may be claimed convenient by reason of some other matter of more or less value. But there, as a rule, the value of a fresh design ends, for the furnace must not be confounded or in any way mixed up with the boiler. It is largely with such points in view that it becomes necessary to be cautious in accepting any claims made for boilers with better efficiency of performance than old-established patterns.

BUSINESS NOTES.

Trade Opportunities in South America. — The *Engineering Magazine* (New York) for September contains an article under the title, "American Trade Opportunities and Handicaps in South America." At the commencement of this article Mr. Lewis R. Freeman, the author, who is said to have spent 18 months in South America carefully studying trade conditions, refers to the beneficial effect of the recent visit of the U.S. Secretary of State to the South American Republics, but remarks that a false impression is abroad that American manufacturers have nothing to do but step in and reap commercially the fruits of the harvest that Mr. Root sowed politically. He goes on to say "that we should, and in time shall, supply the greater part of the wants of our southern neighbours is as undeniable to one who understands our manufacturing potentialities, as is the fact that in the light of our showing to date along this line, there has been little to lead to that conclusion one who has not only watched our disconnected efforts from the outside without appreciating what is behind them; that is to say, any hopes we may legitimately entertain for future supremacy in South American trade should be based less on what we have done than on what we know we can do when the time comes." The "step in and take" idea of the man in the street is based on nothing but his fathomless American confidence and, in this instance, an equally fathomless ignorance regarding the true conditions that prevail in the countries in question.

That the United States has not won first place among the countries exporting to South America is due, in the author's opinion, primarily, to the fact that the United States is not yet as congested with population as her rivals. What great effect this can have in limiting the export trade of the United States is not apparent nor does the author attempt to explain. Other reasons given for the limited trade are the lack of American importing houses and American banks in South America, the need for travellers acquainted with the several countries and their languages; the too hustling nature of the American salesman; the lack of swift and regular steamship lines which must of necessity be subsidised; and the dislike of Americans which is shown in many of the republics. After considering superficially with the usual arguments, these several causes of lack of trade, Mr. Freeman mentions one or two branches of trade, mostly unimportant, in which the United States holds the lead, and then passes on to a lengthy discourse on the subject of the railway systems and rolling stock of South America, as reported on by Mr. P. Seagfield of the Central Uruguay Railway; the intention apparently being to show that British-built railways and rolling stock are vastly inferior to American. Here the article closes without any attempt to substantiate statements made, without drawing any general conclusions, and certainly without giving any great assistance to the manufacturers and capitalists of the United States or any other country.

In the main, the article is extremely misleading, at any rate from the point of view of the electrical trade; it is always easy in commercial reports and articles to extol the virtues of foreign manufacturers and to abuse the manufacturers at home; this the author seems to have done without any consideration for facts. It is certainly difficult to deal at all successfully in one article with the conditions and possibilities of trade in general in a continent like South America, where so many opportunities exist, but the author might at least have said *something* of practical value.

Dealing with the subject from an electrical point of view, it is certainly true that in the River Plate countries, and possibly also in Chile, the German industry holds a predominating position, but in Brazil, Mexico, and Northern South America, the United States has by far the strongest hold whether it be in tramway, light and power, telegraph and telephone enterprises, or in the supply of electrical materials. At any rate, a glance at the official trade statistics of the several republics will prove that Great Britain does not compete to any very great extent in this branch of enterprise and trade.

In this respect the existence of the British importing houses in South America has not helped British trade to the extent one would anticipate from the author's remarks, and whether it can do so is a matter of great doubt, for the fact that the majority of importing houses are British will not prevent them from selling American goods if these prove to be cheaper or better adapted to the needs of the country; moreover, it must be remembered that these houses are purely and simply merchant houses prepared to buy and sell any class of goods which may be in demand at a given time. The employment of competent travellers is certainly of great importance, and that they should speak the language of the country and be conversant with the customs of the people is essential, but manufacturers are, or should be, perfectly alive to this fact after all that has been said and written upon the subject. The necessity for fast and regular steamship lines is also apparent, but in this respect America is far ahead of Great Britain, even if she falls behind Germany, which is doubtful.

In a series of articles recently published in the Electrical Review, on the "Neutral Markets of the World," British capitalists were urged to invest in electrical undertakings in South America, and thereby secure a fair share of a trade which is constantly increasing.

It is obvious that the investment of capital in the undertakings of these countries will have a great effect in promoting a healthy and continuous trade. All the South American countries are now being rapidly opened up, but more capital is still needed. In the electrical trade probably more than in any other, there are great opportunities for expansion; there is an abundance of water power, combined with a shortage of coal, electric lighting is being installed and electric tramways constructed in every direction, and the telegraph and telephone are being more and more utilised.

Whatever may be the case in other trades, in the electrical trade at least, in spite of all that Mr. Freeman may say, it is certain that American capitalists are alive to the possibilities existing in South America, and that British manufacturers and capitalists have not as yet gained that share of the trade which is their due in such an important country.

Factory Electrical Plant Destroyed by Fire.—By a fire that occurred at the plate-glass works of Messrs. Pilkington, St. Helens, last week, a boiler-house containing six boilers, and the dynamo room in which were four dynamo sets and two motor-generators were destroyed. It is stated that a large part of the works is to be shut down until new motive power plant is installed.

Trade Marks in China.—Messrs. W. P. Thompson and Co., patent agents, 6, Lord Street, Liverpool, write as follows:—"It will be remembered that by Article 7 of the Treaty of Shanghai of 1902, the Chinese Government agreed to establish offices within the jurisdiction of the Superintendents of Northern and Southern Trade, where foreign trade marks may be registered on payment of a reasonable fee. The first attempt on the part of the Chinese Government to carry out the provisions of this article was the appearance of some draft regulations drawn up by the Board of Commerce in 1904. This document proved altogether unacceptable to the representatives of several of the foreign Powers, and further steps were taken the following year to prepare a series of trade regulations embodying the main views of the

foreign Governments. At the end of 15 months, the Chinese Government produced a second set of regulations which again were contrary to the ideas of the foreign Governments, and the Powers would have nothing to do with them, and the representatives of the Powers again pointed out what was requisite. Since then the Government appear to have made no further move. Our agent in Shanghai, however, has this morning sent us the translation of a proclamation published by a very powerful man, the Shanghai Taotai, who is apparently Superintendent of Northern Trade, which appears below, and which we understand has the force of law throughout the Northern Provinces, and there is little doubt that punishment will be meted out to those who offend against its provisions."

Proclamation of his Honour the Shanghai Taotai. Translated by the "North China Daily News."

"I, Jui Cheng, the Taotai of Shanghai, &c., do hereby issue this proclamation for the information of the public that H.B.M. Consul-General, Sir P. L. Warren, has written me to the effect that he has repeatedly received complaints from British merchants in regard to Chinese manufacturing and retailing certain qualities of English-made goods, purporting same to be manufactured by those factories, for which they (the British merchants) are the sole agents. This is a great detriment to the British interests. The quality of the goods which are imitated according to English patterns is very poor and of great difference, although the packing, colour, pattern and chop are quite similar to those of English made. Therefore when the Chinese is charged with copying patterns, he generally denies the charge by pointing out the slight difference of patterns between the two kinds of goods. This is a very intolerable business competition in the market. Recently such malpractice is daily increasing, and, therefore, litigation on this question will keep on increasing also. As such would more or less strain the commercial relation of the two countries, he requests me to prohibit further copying of patterns by Chinese people. The Chinese Chamber of Commerce, upon being notified of this matter, has replied that such prohibition is the right step taken for commercial protection, and asks to be informed of the different patterns which are most frequently being copied in order to co-operate in the prohibition. In compliance with my request the British Consul-General has furnished me with a list of the cigarettes manufactured by the British-American Tobacco Co., Ltd., Depôt, and also a list of the soaps, for which Messrs. A. R. Burkill & Sons are the sole agents: these two articles are more often manufactured by the native according to their patterns. The Consul-General says that he has on several occasions called the attention of the Viceroy of Nanking to this matter, and, moreover, he requests me to issue this proclamation to be posted everywhere to prohibit further imitation of English-made goods. The Chamber of Commerce having been asked to observe this order, I hereby warn the general public that henceforth such malpractice on the part of our people should once and for all be stopped. Anyone found to be violating this law will be punished without leniency.

"*August 20th*, 1907."

Haste Pumps.—The Haste Pump Co., Ltd., have recently received a contract from the War Office for two further sets of surface condensing plants, including their inverted type pattern of Edwards patent air-pumps, making in all five sets of plants of the same design, each capable of dealing with 27,000 lb. of steam per hour. Other contracts recently booked by the company are:—

One boiler feed pump for the Southwark Corporation Electricity Works, to deliver 4,000 gallons per hour against 200 lb. pressure.

One set of three-throw Edwards air-pumps of their new inverted type, for the Electrolytic Alkali Co., Ltd., of Middlewich, the plant to be steam-driven, self-contained, and capable of dealing with 55,000 lb. of steam per hour.

Two large filters of the Wilson patent self-flushing type, to the order of Messrs. Davis, Perrett & Co., Ltd., for Edinburgh and Monte Video. Besides a number of air-pumps and small condensers to the orders of different shipping agents in this country, equal to 350,000 (total) lb. of steam per hour.

Accident at a Birmingham Works.—We are asked to state that an accident has taken place at the Birmingham Engineering Co.'s works, due to the breakage of a heavy main driving belt. This belt had previously shown no signs of giving out, and the breakage took place without any warning. After breaking, the belt proceeded to wrap itself round the shafting, and, at the same time, also to encircle the main driving pulley of the shop engine, with the inevitable result of causing an abrupt stoppage of the line shaft, accompanied by considerable derangement of its normal position! The shaft was twisted about in a quite extraordinary manner and one of the massive cross-beams carrying the shafting was torn from its position in the walls of the building. Under the circumstances it has been necessary to close a portion of the works for a short time, but it is hoped that the damage will be repaired in a week or 10 days. Happily, the accident was unattended with any personal injury, although the shop was in full swing at the time; the damage to the engine itself is not of a very serious nature, the principal harm having been to the line shafting and its supports.

Catalogues and Lists.—Messrs. Dorman & Smith, Ordsal Electrical Works, Salford, Manchester.—New complete catalogue (No. 87), which is being issued this week, relating to their fuses, switchgear, accessories, fittings, &c. It is finely produced, with good illustrations on art paper, and is in a neat binding with a very effective front cover. It has altogether some 97 pages of matter, as compared to 71 pages in the last edition. Many new patterns of water-tight and iron-cased articles, such as switches and fuses, are shown, including a combined inter-locked switch and plug, and new water-tight plugs for large currents up to 100 amperes. The fuse section is also somewhat enlarged, and includes several new types. Several new forms of the firm's liquid motor-starters are shown, including one for three-phase work. The grip-contact circuit-breakers, which have become such a large and important branch of their business, are very fully illustrated, and patterns suitable for three-phase work and water-tight enclosed circuit-breakers are shown for the first time. In the water-tight iron fittings section, several new and useful types of oyster fittings are shown; also cluster fittings and single light fittings, with extra deep glasses suitable for the new Osram lamp, which is now coming largely into use. Several new forms of inexpensive cargo cluster fittings are shown, the series now being very complete. The small switch section is brought up to date by the inclusion of the new slipper type switch. In the fittings and accessories section will be observed an extension of the system, already introduced with considerable success in previous editions, of the firm's lists of reduced prices on large consignments. The selling expenses, such as invoicing, packing up, &c., are almost identical, whether the consignment is large or small, and by this method of graduated price the buyer gets the advantage of the economy effected by buying in larger parcels automatically, without the trouble and loss of time involved by asking for a special quotation.

Messrs. Wassermann & Co., Lausanne, and 11, Queen Victoria Street, E.C. (general agent in this country, Mr. T. W. Sheffield).—Eight-page pamphlet giving information concerning the "Castolin" process for brazing cast-iron. Some particulars of tests made in London regarding the resistance of a number of bars to pulling and bending stresses, are published.

Messrs. Wilkinson, Heywood & Clark, Ltd., 7, Caledonian Road, London, N.—A strongly bound and finely prepared collection of 156 plates of arms, coronets, monograms, lettering, and so forth, for carriage purposes, also a full collection of borough coats of arms. The firm specialises in varnishes, enamels and colours for carriage, motor-car and wooden body builders. "Falconite" white enamel, and "Philorite" enamel filling composition are among its other lines.

Messrs. G. Straus & Co., Ltd., 211, Upper Thames Street, E.C.—Priced circular relating to their "Just-Wolfram" lamp.

Mr. G. Braulik, 217-218, Upper Thames Street, E.C.—Price list of "Eclipse" flame arc lamps.

Messrs. Bagshawe & Co., Ltd., Tower Royal, London, E.C.—Price list of "Gray's" style chains.

Mr. Charles Taylor, Bartholomew Street, Birmingham.—Well-illustrated catalogue showing and describing his patent spiral self-centring chucks. Reduced prices are announced which are made possible through the installation of a new and modernly-equipped works expressly designed for the production of these chucks.

Mr. O. N. Beck, 11, Queen Victoria Street, E.C.—Descriptive circular concerning his Universal expansion joints for high-pressure piping, with illustrations and prices.

Messrs. Geipel & Lange, London, S.E.—Illustrated price lists of the Henrion arc lamp carbons, and incandescent lamps.

Messrs. Bradbury & Co., 39-40, Woodcock Street, Birmingham.—Illustrated circular of some cheap lines in electric light fittings, brackets, ceiling fittings, and so forth, in polished brass; also a similar circular showing hand-wrought bracket lamps in black iron with copper domes, and hand-wrought radiators. Both lists give prices. Contractors can have a number of these circulars without the firm's name, on application.

Messrs. Robert Boyle & Son, 64, Holborn Viaduct, E.C.—Booklet relating to the "Boyle" system of natural ventilation.

Kryptol.—In the notice of Kryptol heating apparatus, which appeared on pages 510 and 511 of our last issue, fig. 72 should have been described as a Cartridge hot plate. Fig. 74 (which a printer's error rendered 47 in the letterpress) is the loose Kryptol furnace.

Bankruptcy Proceedings.—David Roberts, electrical and motor engineer, Whiston Street, Derby.—First and final dividend of 6s. 8d. in the £, payable September 30th, at Official Receiver's Office, 47, Full Street, Derby.

Trade Announcements.—New business premises have been opened at the junction of Chertsey Street and North Street, Guildford, by Messrs. H. Fentum Phillips & Co., electrical engineers.

Messrs. F. W. Smith & Co., electrical engineers, of Salford, Manchester, have removed their business from 181 and 183, Chapel Street, to 12, Tib Lane, Cross Street.

In reference to our notice concerning the dissolution of partnership of W. Mackie & Co., we now learn that Mr. W. Mackie has made arrangements with his late partners to acquire and carry on the business of W. Mackie & Co. at 122 and 124, Golden Lane, E.C., as hitherto.

Mr. G. Braulik, of Upper Thames Street, E.C., is a wholesale agent for Messrs. Phillips's carbon and metallic filament lamps, to which reference was made in our last issue.

The present address of Messrs. Woodhouse Bros. is 66, Scotland Road, Liverpool (telephone No. 2039 Royal).

Communications for the Kent Electric Power Co. should in future be addressed to Frindsbury Power House, Strood, Kent, instead of to Chatham.

Mr. John A. Smeeton has resigned his position as London manager to Messrs. Richardsons, Westgarth & Co., Ltd., and has accepted the position of London managing director to the Fusion-Welded Metals, Ltd., a company recently formed to exploit a new invention for welding copper and various alloys on to steel, and for welding together any two classes of steel by means of copper or any alloy. The Fusion-Welded Metals, Ltd., have opened offices at 56, Victoria Street, S.W.

Book Notices.—*The Engineering Index Annual.* 1906. London: The *Engineering Magazine.* 1907. Price 10s.—As announced in our last notice of the *Index*, this valuable work of reference is now published annually, instead of quinquennially, an arrangement which constitutes an immense improvement on the earlier plan. We now have some 250 technical and engineering journals indexed up to the end of 1906; what this means can only be adequately appreciated by those who, from time to time, have found it necessary to hunt for articles and information on some specific subject, amid the enormous mass of technical literature poured forth nowadays. Our high opinion of the *Index* has been repeatedly recorded, and we can only add that it grows with each new volume.

British Standard Specification for Copper Alloy Bars.—London: Crosby Lockwood & Son. 1907. Price 2s. 6d. net.—This specification deals with copper alloy bars for use in automatic machines, on similar lines to the specification for steel bars issued in May last. The material is divided into two classes; in Class B no mechanical tests are imposed, but in Class A, such tests are imposed for the smaller bars. Standard dimensions are tabulated, and the forms of B.S. tensile test pieces are defined. The composition of the alloys, however, is not here specified.

Everybody's Guide to Electricity. By E. Pierce. London: Madgwick, Houlston & Co. 1907. Price 6d.—This is one of a series of small handbooks of the "popular" class. The units are correctly defined, and attention is drawn to the distinction between power and energy, so often ignored in such works; but a slight difficulty is raised by the use of "v. joule" on page 11, where v. looks like an abbreviation for "volts" instead of "vide." The contents of the book in general resemble those of similar works, the figures being obviously derived mainly from manufacturers' catalogues, &c., with descriptions to match; the subject is well handled on the whole, and in the small space available a large range of apparatus, &c., is covered.

The Gas Works Directory and Statistics, 1907-8. London: Hazell, Watson & Viney, Ltd. 10s. 6d.—This is the thirtieth edition of this publication, and it is revised to July, 1907. An alphabetical list of gas lighting works officials leads the way, and a great deal of serviceable information follows relating to the various gas supply undertakings of the kingdom. Wherever there is a public electricity supply service, this fact is indicated.

"Les Industries Electrochimiques." By J. Escard. Paris: Ch. Béranger. 1907. Price 25 fr.

Papers and Reports Relating to Minerals and Mining in New Zealand. Wellington, N.Z.: J. Mackay. 1907.

Fire Tests with Fire Extinguishers. The "Minimax" Extinguisher; Committee's report. Red Book of the British Fire Prevention Committee. No. 121. London: British Fire Prevention Committee. 1907. Price 2s. 6d.

Fire Tests with Hydrants. A hydrant fitted with an "Adaptor." Committee's report. Red books of the British Fire Prevention Committee. No. 123. London: British Fire Prevention Committee. 1907. Price 2s. 6d.

"Proceedings of the American Institute of Electrical Engineers." August, 1907. Vol. 24, No. 8. New York: The Institute. Price 50 cents.

Fires.—On Tuesday the premises of Messrs. J. G. White and Co., Ltd., electrical engineers, in College Hill, E.C., were partially damaged by fire.

A Leeds paper says that the Ampere Electrical Engineering Works of Mr. F. Rhodes, Commercial Street, Morley, were destroyed by fire on 20th ult.

Meeting of Creditors.—On Tuesday, before Mr. G. W. Chapman, Official Receiver, a meeting of creditors was held under the failure of John Dixon Gibbs, of Linden Gardens, Bayswater, W., whose statement of affairs showed liabilities £13,990 and assets, consisting of commission letters, of uncertain value. According to the Official Receiver's observations, the debtor, who is 74 years of age, formerly held a direct cavalry appointment in the East India Co.'s service. Since 1867 he has had no regular occupation, but has been connected with electrical and other undertakings in France, Russia and England, and has also been a director of several companies. The debtor attributes his failure to loss of a patent through the adverse judgment of the House of Lords in 1890, and to the stoppage of his credit through the action of his bankers in 1903. The meeting was adjourned for three weeks to give the debtor an opportunity to submit a proposal.

New Zealand Electrical Tariffs.—According to the *New Zealand Herald* of July 30th, the Minister for Customs has been waited upon by Mr. J. Salinger, of Auckland, in reference to the proposed increase of the duty on electrical fittings from 10 to 20 per cent. Mr. Millar stated that he was quite willing to allow electrical appliances and fittings to come in at 10 per cent. Dynamos and motors, as electrical machinery, should, however, he said, be subject to a duty of 20 per cent. if imported complete, but if brought in in parts, in an incomplete state (thus necessitating employment of local labour to complete them), he thought they should be admitted for 10 per cent., or possibly free of duty. The Minister asked to be supplied with a list of articles which were regarded as coming under the designation of fittings.

Bangkok Electrical Illuminations.—To greet the King of Siam on his return to Bangkok, the Palace and Port are to be extensively decorated with electric illuminating devices throughout. Messrs. Veritys, Ltd., received a cable order for over 10,000 ft. of Fairyland Strip on Monday, September 23rd, for delivery by the following Friday night. They succeeded in completing the whole of the order within the time specified, *i.e.*, at the rate of over 2,000 ft. per day. The material was despatched by passenger train and mail steamer, and it required the combined efforts of a small army of porters with 14 lorries to get same on board.

LIGHTING and POWER NOTES.

Belfast.—The L.G.B. has sanctioned the borrowing of £75,000 by the Corporation for extensions in connection with the electricity undertaking.

Brighouse.—The T.C. on September 25th decided to take energy in bulk from the Yorkshire Electric Power Co. for 14 years, the charge not to exceed 1½d. per unit, with a revision of price at the end of seven years. The Council will erect the transforming sub-station, and provide switchboard and balancer, and the company will put down all transforming plant and apparatus.

Coatbridge.—At the Valuation Court, the Airdrie and Coatbridge Electricity Supply Co. appealed against the assessment of £633, which had been placed on its works, seeking to have the sum reduced to £160. The question raised was whether the valuation should be arrived at by the estimated expenditure for the present year or the actual expenditure of last year, as shown in the balance-sheet. The Court upheld the assessor's calculations, and fixed the amount at £633.

Continental Notes.—France.—The Minister of Marine has decided to establish electrical works to provide the motive power required for lighting the workshops of the Cherbourg arsenal, and for charging the accumulators of submarines. Similar works will be erected at other ports if the results obtained at Cherbourg are satisfactory.

Spain.—A large electric power plant, in which water-power is utilised, has lately been completed at El Duero by La Sociedad El Porvenir de Zamora. The plant includes two three-phase alternators, each of 400 kw. capacity, and five similar machines of 800 kw. The current generated is transmitted for lighting and power purposes to Zamora and Salamanca at a pressure of 20,000 volts, and to Valladollid at 40,000 volts, the transmission distance in the case of the last-named town being 110 kilometres.

Germany.—Owing to a burn-out in the cable network on September 25th, the town of Charlottenburg was left practically in darkness for a night, the electric tramway service also being suspended.

Greenock.—An adjourned meeting of Greenock Valuation Appeal Court was held last week, to consider the valuation of the burgh electricity works. Mr. Hamilton (Assessor) stated that the figure on the roll last year was £5,440, and that it had been proposed to increase it to £5,770. This was appealed against, and as a result of negotiations fixed at £5,250.

Greetland.—Halifax Tramways and Electricity Committee has decided not to entertain the suggestion that the T.C. should agree to take over a prov. order for E.L., on its being obtained by the U.D.C., and pay the costs.

Heswall.—A poll taken in the area of the Heswall Parish Council has resulted in a majority being obtained favourable to the lighting of the streets of the township by the Council. Proposals have been made for lighting the area by electricity, and the Council has decided to instruct its solicitor to prepare an agreement, in conjunction with the solicitor of the company, which is willing to carry out the work.

Ingleton.—The P.C. has accepted the tender of the E.L. Co. for lighting the parish at £40 for the season.

London.—Southwark.—Messrs. Price, Waterhouse and Co. some months ago drew up a report on the Southwark electricity accounts at the request of a private ratepayer. In June last Mr. Carson Roberts, public auditor, criticised that report, and Messrs. Price, Waterhouse & Co. have forwarded the Council a letter on that criticism, which says, *inter alia*:—"Mr. Carson Roberts approaches the matter from a different point from that adopted by us. We concerned ourselves with the question of the provision of a cash fund to be available for renewals as and when they may be estimated to fall due; he is evidently concerned rather with the equalisation of the charge for renewals over a largely extended term of years. The two objects are incompatible with one another under the system by which the capital expenditure of your Council has perforce been financed, and Mr. Carson Roberts's calculation of the result which would be achieved by an accummulation extending over 42 years, only tends to show that under the system of finance which has had to be adopted, a heavier burden than their fair share must fall upon the earlier years' revenue, if a cash fund is to be provided to cover all renewals as the necessity for them arises."

Manchester.—The Corporation has proposed terms for a temporary supply of energy from the Salford Corporation during the coming winter. The latter authority were expected to formally agree to the terms during the past week.

Peterborough.—The T.C. has received from the L.G.B. sanction to a loan of £2,280 for electricity purposes.

Renfrew.—The trustees of the Clyde Navigation have entered into an agreement with the Clyde Valley Electrical Power Co. for the supply of electricity to the Renfrew workshops of the trust.

Southampton.—The T.C. has decided to obtain Parliamentary powers to undertake free and assisted wiring, to install wires, fittings, &c., and to hire out arc lamps, heating apparatus and motors, either on the rental or deferred payment system.

Victoria Falls Power Scheme.—Mr. Ralph D. Mershon, of New York, who has just returned from South Africa, after inspecting the Victoria Falls both above and below the Gorge on behalf of the Power Co., states that an excellent electrical development could be made up to if need be 300,000 H.P.; and if means were taken, which could probably be done very economically, to conserve the water some little distance back from the Falls, there would be a further large addition to the power that would be available. Mr. Mershon added that the immediate work which the company had to concern itself with was the early provision of a further steam-driven electrical generating station on the Rand. At the moment the company with its two existing stations was quite unable to cope with the demand for power, and had been compelled in advance of the erection of the new station to arrange for an extension of the existing station at Brakpan.

Ware.—The U.D.C. has decided to call the attention of the North Metropolitan Electric Power Distribution Co. to the fact that the time allowed for carrying out the E.L. order expired last month.

West Bromwich.—The T.C. has received sanction to raise a loan of £3,586 in respect of excess expenditure at the electricity works, and for a loan of £2,000 for mains and services.

Wimbledon.—At the suggestion of the borough electrical engineer, a sub-committee has been appointed to consider and report as to what additional plant it is desirable to install at the generating station in order to meet the probable demand for energy during the winter of 1908-9. The Committee has approved of detailed plans for a modern type remote-control main switchboard, containing eight generator panels and six feeder panels in substitution for the present switchboard at the electricity works. The estimated cost of the switchboard is £2,500, and the estimated cost of the structural alterations in the building is £1,100. "Tantalum" lamps are to be purchased for fixing in the Ridgway, Queen's Road and South Park Road.

Wraysbury.—The P.C. has requested that the parish shall not be included in the prov. order for E.L. being applied for by the Woking Electric Supply Co., as there are other companies much nearer who can supply the parish.

TRAMWAY and RAILWAY NOTES.

Barking.—The Board of Trade is in receipt of a communication from the U.D.C. asking the Board to endeavour to settle the terms under which inter-running with the Ilford tramways may be arranged.

Birmingham.—Owing, it is stated, to the failure of the magnetic brake, a tramcar which was descending a hill, on Monday, jumped the metals and overturned, two persons being killed and fifteen injured.

Bradford.—It is expected that the extension of the Corporation tramways system to Wibsey *via* Brownroyd Hill will be completed by the end of the week.

Canada.—An electric block signal system, invented by Mr. H. W. Price, lecturer on applied electricity in the University of Toronto, has been given an exhaustive test by the Intercolonial Railway at Moncton, N.B. Besides causing the application of brakes, the signal also causes a whistle in the locomotive cab to sound. The system guards against both head-on and rear-end collisions. The tests were entirely successful, and the adoption of the system on the Intercolonial Railway is very probable.

An electric railway, 62 miles in length and to cost $2,500,000, was begun last week by the British Columbia Electric Railway Co. to Chilliwack, and is expected to be in operation within two years.

Continental Notes.—SPAIN.—La Sociedad El Tibidabo has applied for a concession for the construction and working of an electric railway between Tibidabo and Belen.

Darlington.—After trying for a period a system of 1d. fares, the local Tramway Committee has resolved to recommend the Town Council to return to the system of ½d. fares.

Glasgow.—At a meeting of the shareholders of the District Subway Co. (Cable), a shareholder inquired the probable cost of converting the subway to electric traction. The chairman said they had had people offering to do it at from £60,000 up to £250,000. For himself, he thought it would take about £100,000, but if they were to purchase electricity from the Corporation, which, he thought, would be the best way, it could be done for much less.

Glasgow.—The magistrates have received a deputation from the Tramways Committee of the T.C., in regard to the danger arising from fast travelling vehicles passing between the tramway cars and the kerb when passengers are boarding and leaving cars at stopping stations. The magistrates remitted the matter to a sub-committee.

Hours of Labour on Railways.—The B. of T. has issued a report on the proceedings under the Railway Regulation Act, 1893, during the year ended July 27th, 1907. It appears that, with one exception, no complaints were made in the term in question that the hours of labour worked on any of the electric railways in the United Kingdom were excessive, or do not provide sufficient intervals of uninterrupted rest between the periods of duty, or sufficient relief in respect of Sunday duty. The exception relates to the staff employed at stations between Ealing Broadway and Hammersmith, on the Metropolitan District Railway. The B. of T. inquired into the representations which were made, and while it appeared that the booked hours had been exceeded in a few instances, the company explained that the circumstances under which this had occurred were exceptional. The report states that further action did not, therefore, seem necessary. The system pursued by the B. of T. is to communicate with the railway companies on the subject of the hours of labour without in general making known the source of the representation upon which the action of the Board is founded. The Board has no reason to think that the companies would visit displeasure upon servants who make representations to the department, but the men are held to be entitled to an assurance that communications addressed to the Board will be treated as confidential, unless they are willing that the origin of their representations should be disclosed.

Kilmarnock.—At a special meeting, the T.C. had under discussion the question of management expenses in connection with the electricity and the tramway departments. The Electricity Committee submitted a report recommending the saving of £227, which included a reduction of £80 in the salary of the general manager, a reduction of £10 in the salary of the traffic manager, dispensing with one ticket inspector, while the post of assistant engineer presently vacant, was not to be filled up. The report, so far as it concerned the general manager, was adopted by 12 votes to 8. Satisfaction was expressed with the general manager's services, but the Council felt bound to effect some economy in management expenses owing to the loss on the tramways.

Leith.—The question of extending the local tramways has been under consideration, and a preliminary report has been prepared by the tramways manager, indicating some seven miles of new routes, which would connect up to Portobello, Davidson's Mains and Granton, and cost some £77,000. It is proposed to ask the Edinburgh Corporation to share the cost of constructing some of the routes which would lie on roads mutually owned by that city and Leith.

Llandudno.—Col. P. von Donop (Inspector of the B. of T.) on Friday, September 27th, made the official inspection of the electric railway from Rhos-on-Sea, through Craigydon and the centre of Llandudno to the West Shore of Llandudno. About six miles of route has been constructed, and it is expected that instructions will be received by the contractor shortly to proceed with the extension of the line from Rhos through the town of Colwyn Bay, the greater part of the material for which is already on the ground.

Manchester and Salford.—The tramway managers of Manchester and Salford, in a joint report, speak favourably of the scheme of through running of cars between the city and borough, and make certain recommendations. The Manchester Tramways Committee, at a recent meeting, adopted a resolution to establish a through route between Swinton and Belle Vue. The terms will be specified in an agreement to be entered into between the two Corporations.

The Traffic and Staff Sub-Committee of the Manchester Tramways Committee recently applied to the Watch Committee of the Manchester Corporation for a license to run two motor-omnibuses along Barlow Moor Road, between the Palatine Road terminus and High Lane, Chorlton-cum-Hardy. The Watch Committee refused the application. The Tramways Committee thereupon ordered the abandonment of the horse-omnibus service which has hitherto existed on that route, and disposed of their horses. An electric tramway between Palatine Road and Chorlton-cum-Hardy is not at present contemplated.

Middlesex.—The County Council of Middlesex is negotiating with the L.C.C. and local authorities with regard to obtaining powers for running a line of tramways from Cricklewood to Harrow road.

New York.—Since the completion of the new Belmont tunnel, connecting New York and Long Island City, the railway authorities have been conducting a series of experimental trips in a specially-constructed steel car. On Saturday last a short-circuit occurred on a car containing 25 passengers, who attempted to jump from the car in order to escape the fumes and flames. The motorman fortunately succeeded in driving the car to the tunnel entrance before the power failed.

North-Eastern Railway Electrification.—Contrary to popular belief, Mr. A. Kaye Butterworth, the general manager of the North-Eastern Railway Co., states that there is no foundation whatever for the report that the company is embarking upon a scheme for the electrification of its Newcastle, Gateshead and South Shields branch lines.

Rotherham.—The Tramways Committee has recommended the T.C. to proceed with the construction of a new line of tramways from Effingham Square to Bradgate.

Wakefield.—The East and West Ardsley Urban District Council has decided to send a deputation to the B. of T. in opposition to the application of the Wakefield and District Light Railways Co., which asks for a direction that its powers shall cease as regards the proposed tramway between Wakefield and East Ardsley. The Light Railways Co. contends that there was no agreement that the Ardsley line should be constructed, and it urges that it is inconsistent with public policy to endeavour to force it into raising money for constructing a line which, it feels convinced, would not pay interest on the cost of construction.

York.—At a meeting of the Tramways Committee of the Corporation on September 25th, it was unanimously resolved to recommend the City Council to apply to the B. of T. in November next for a Light Railway Order, or a Provisional Order, authorising the Council to construct or lease certain tramways within the city boundary. Before exercising any powers, a poll of the citizens will be taken to determine whether the Corporation shall work the tramways or lease them to a company.

TELEGRAPH and TELEPHONE NOTES.

An Alarming System.—"A new wireless telegraph and alarm system," says the *Daily News*, has been invented by an electrician of—need we say it?—San Francisco. It consists of a wireless telegraph apparatus carried in the pocket or hat (*sic*) of a policeman. When "the chief turns on the current of his batteries" at headquarters, wireless messages are sent in all directions. The policeman hears a bell ring in his pocket, calling his attention; the message is sent "in the form of dots and dashes, and although the policeman may not understand this form of communication, he will know that he is wanted, and will hasten to telephone to the police station."

The spectacle of all the policemen in San Francisco simultaneously rushing to telephones will be interesting. In future one will say of a policeman, not that he has a bee in his bonnet, but that he is dotty in the "hat."

Canada.—The Royal Commission appointed to consider the strike of the Toronto telephone operators has reported in favour of the latter, alleging that the Bell Telephone Co. has practically sweated its employés. The Commissioners consider that legislative action is necessary; they say that six hours' work a day is enough, that overtime should be prohibited, and that the minimum age of employés should be fixed at 18. The company had reverted from a five-hour day to eight hours, and paid from $20 to $30 a month.

Electric Dispatch.—It is reported that the Piscicelli system for the carriage of mails at high speed has been resurrected in Italy, and that the Italian Government is considering the matter with a view to establishing an "electric post" between the principal cities in Italy.

New Exchange.—On Saturday afternoon last the National Telephone Co. changed over from the old exchange at Gerrard Street to the new one on the common battery system, 12,000 wires being transferred in nine minutes. The new exchange is much more spacious than the old one, and will eventually be the largest possessed by the company when the old building has been rebuilt and equipped as an extension of the new one. All modern conveniences, precautions against fire, &c., have been embodied in the new exchange.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo } Closed..	Jan. 12, 1906 ..	..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904 ..	..
Garachico-Santa Cruz	July 12, 1906 ..	..
Las Palmas-Arecife	Aug. 18, 1906 ..	..
Brest-Dakar	July 22, 1907 ..	..
Midway Island-Guam	Sept. 22, 1907 ..	..
New York-Cape Haytien	Sept. 22, 1907 ..	Sept. 30.
Martinique-Paramaribo	Sept. 25, 1907 ..	..
Landlines.		
Puerto-Barrios	Aug. 2, 1909 ..	..

Telegraphists' Strike in the U.S.A.—The strike has now lasted over seven weeks, and both sides are still obstinate, although the strikers are badly in need of funds.

Telephone Charges.—The agitation against the new measured rate tariff for telephone service continues with growing intensity in the provinces. It is alleged that one result of the new tariff will be that the price to be paid to the National Telephone Co. for its business in 1911 will be increased.

At the half-yearly Conference of the National Chamber of Trade at Blackburn, on September 26th, the Chamber passed resolutions condemning the new telephone rates as calculated to restrict the use of the telephone, and to place the commercial community at a disadvantage compared with other countries, also favouring a system of municipal telephone administration after 1911.

Wireless Record.—The Central News reports that on September 27th the United States cruiser *Pennsylvania*, when 1,000 miles off the Pacific Coast, was in wireless communication with the town of Savannah (Georgia), 4,000 miles distant on the other side of the continent.

Wireless Telegraphy.—During the next four months the Germany Army authorities are to carry out experiments in wireless telegraphy at Metz, Strasburg and other fortresses; 1,000 military telegraphists from the reserve have been called up to work with the army telegraphists.

Wireless Telephony.—The U.S. Navy Department, says the *Electrical World*, will equip with wireless telephone apparatus all the battleships going to the Pacific, the apparatus being guaranteed to have a speaking range of 5 miles in all weathers.

Communication has been established across the city of Berlin, on the Poulsen system, over a distance of 10 miles.

CONTRACTS OPEN and CLOSED.

OPEN.

Antwerp.—October 17th. The municipal authorities are calling for tenders for the installation of electric light in the Salle de Fêtes recently erected in the Place de Meir, Antwerp. A deposit of 8,000 francs (about £320) will be required to qualify any tender. Specifications from the Hotel de Ville, Antwerp, at a cost of 0·50 franc. A copy may be inspected by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

Argentine Republic.—The municipal authorities of Buenos Ayres are reported to be about to invite tenders for the concession for the construction and working of an underground electric tramway in the city.

Austria.—October 15th. The Municipal Authorities of Schoenberg, in Mähren, require tenders by October 15th for the erection, equipment, &c., of a central power station. Details may be obtained from the Bürgermeisteramt (Abtheilung Bauamt), of Nähr-Schönberg.

Australia.—New South Wales.—October 23rd. Galvanised iron wire, 1,600 insulators and 500 wall telephones, for the G.P.O., Sydney. Specifications, &c., may be seen at the Electrical Review offices.

Melbourne.—November 12th. 6,000 dry cells for the Deputy Postmaster-General of Victoria. Commonwealth Offices, 72, Victoria Street, S.W., or Board of Trade Commercial Intelligence Department. Specification can be seen at the offices of the Electrical Review.

New South Wales.—October 30th. The Postmaster-General at Sydney requires tenders for 21,000 best white porcelain insulators; 55½ tons hard-drawn copper wire, 300 lb. per mile; 15 cwt. copper binding tape, 300 lb. per mile; 62 tons galvanised iron wire, 500 lb. per mile.

New South Wales. — November 6th. Postmaster-General's department. Tenders are required by November 6th as follows:—14½ tons hard-drawn copper wire (300 lb. per mile); 4 cwt. copper binding tape (200 lb. per mile, ⅞ in. wide); 3,500 large insulators (best white porcelain); 1,000 tallow-wood cross-arms, 3 ft. 10 in., complete; 2,500 ditto, 5 ft. 2 in. Specifications and general conditions may be seen at the office of the Electrical Review.

New South Wales.—December 11th. Tenders will be received at the office of the Deputy Postmaster-General, Sydney, for the supply and delivery, at the Central Exchange, General Post Office, Sydney, of the following: 1,000 telephones, wall, common battery; 100 telephones, table, common battery. Specifications may be seen at the office of the Electrical Review.

New South Wales.—Sydney.—November 6th. The Water and Sewerage Board require tenders for centrifugal pumps and electric motors for the low-level sewerage system of Sydney.

South Australia.—January 8th, 1908. One common-battery switchboard and 3,000 subscribers' telephones (specification No. 166) for the Deputy Postmaster-General, Adelaide. Specifications can be seen at the Commonwealth Office, 72, Victoria Street, S.W.

Victoria.—January 7th, 1908. The Postmaster-General requires tenders for 11 sections of a common-battery switchboard and 3,000 subscribers' telephones and other apparatus, for the telephone exchange at Windsor.

Belgium.—(No date fixed.) The Belgian State Railways, 11, Rue de Louvain, Brussels, will shortly call for tenders for annual supplies of materials and appliances for lighting trains by electricity.

They also require for Tournai Railway station supplies as follows: (1) 36 iron standards; (2) two switchboards; (3) fittings; (4) insulators; (5) bronze wire, &c.; (6) insulated cable and wire; (7) galvanised iron wire, 7 mm. in diameter, hoisting cable, &c.

The municipal authorities of Flemalle-Haute (province of Liége) have just invited tenders for the concession for the public and private electric lighting of the town.

(*Continued on page 575.*)

HIGH-LIFT TURBINE PUMPS.

Owing to the developments which have taken place in recent years in the design of pumps of the centrifugal type, the field of application for pumps of this class has been greatly extended, so that nowadays they can be employed for almost any degree of lift without any loss of efficiency. A number of pumps of this class have been designed, and are manufactured, by Messrs. W. H. Allen, Son & Co., Ltd., of Bedford. The work which this company has done for many years in connection with hydraulic machinery is now well known, and it is only reasonable to expect that in applying its large experience to any new departure in hydraulic machinery, it should produce an article of the very highest class. The centrifugal turbine pump has always been recognised as the type of pump which combines the greatest simplicity of construction with the lowest first cost, but until recently, its use has practically been confined to comparatively low lifts. The application of this type of pump to high lifts has necessitated many modifications in design in order to reduce the hydraulic friction to a minimum, and to enable the use of high speeds of revolution. The makers have now brought the efficiency of these pumps to the very highest point, enabling them to be employed for all heads under which pumps of the ram type have hitherto operated, and owing to the small space required, they can be employed under many conditions to which the ram type is not readily applicable.

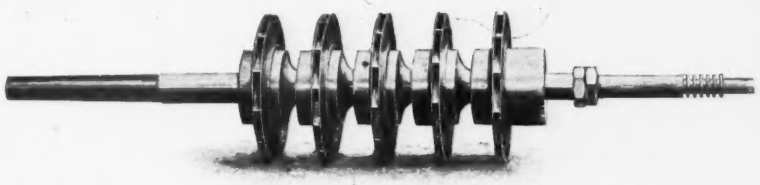


Fig. 1.—Impellers and Balancing Piston, Allen Turbine Pump.

These pumps are suitable for use on colliery and iron-working plants, for sewage plants, circulating water, fire, irrigation, hydraulic mining, and a variety of other purposes.

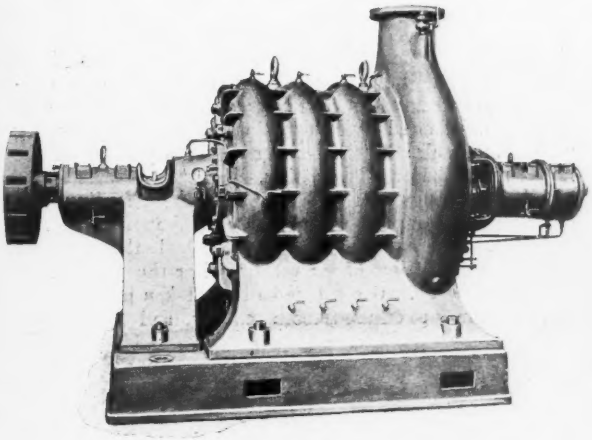


Fig. 2.—Five-stage Turbine Pump.

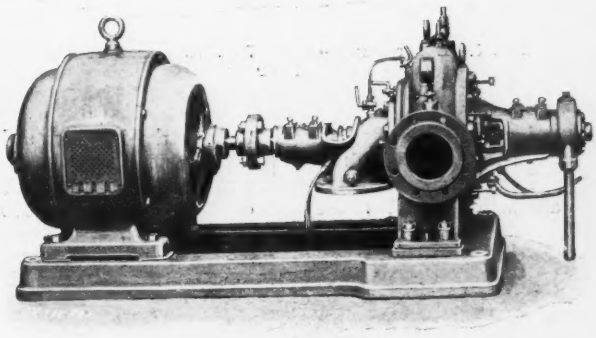


Fig. 3.—Electrically-driven Two-stage Turbine Pump.

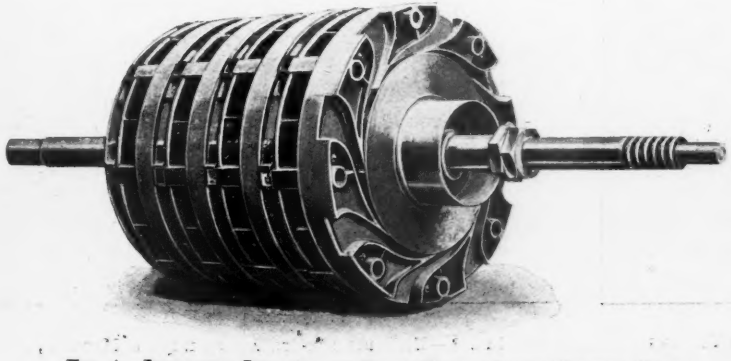


Fig. 4.—Impellers Inserted in Guide Vanes, Allen Turbine Pump.

As the pump is perfectly balanced, there is no need for heavy foundations, and in this point alone a considerable saving can be effected by the adoption of these pumps instead of those of the ram type.

Only the best materials and workmanship are employed in the production of these pumps. The accompanying illustrations give some idea of their external appearance and finish.

Fig. 3 shows a 4-in. two-stage series pump, driven by an alternating current motor, to deliver 250 gallons of water per minute against a head of 240 ft. when running at a speed of 2,900 R.P.M.

Fig. 2 is a large 12-in. five-stage series pump, for delivering 1,700 gallons of water per minute against a head of 250 ft. when running at 450 R.P.M. It is arranged for coupling to one of

Messrs. Allen's high-speed engines, by means of a flexible coupling on the Zodel-Voigt system. Fig. 4 shows the blades and impellers and spindle when withdrawn from the

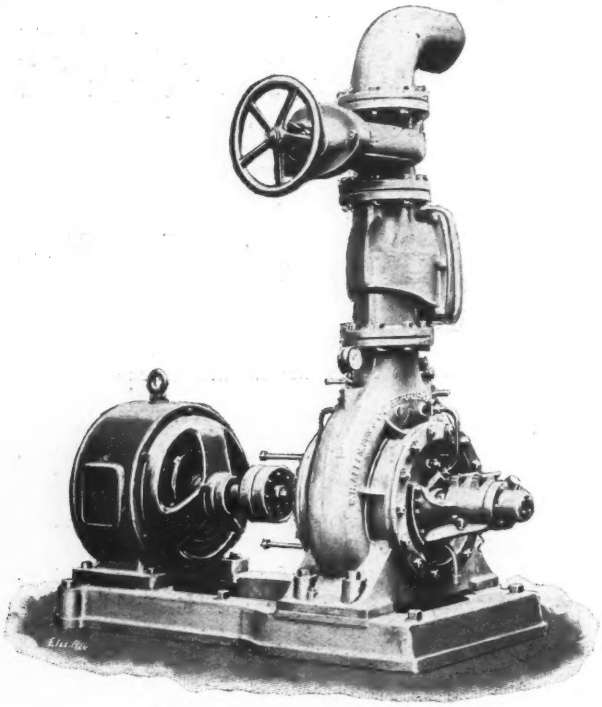


Fig. 5.—Electrically-driven 7-in. Two-stage Turbine Pump.

casing of this pump, and fig. 1 shows the impellers and balancing piston when mounted upon the spindle.

Fig. 5 shows a 7-in. two-stage series pump coupled to an alternating-current motor and capable of delivering 600 gallons of water per minute against a head of 120 ft. when running at 1,760 r.p.m.

The casing is usually constructed of cast-iron and the spindle of nickel steel, the latter being protected in the glands by bronze sleeves; the impellers and guide vanes are usually of high-tension bronze. The impellers are all mounted upon the same spindle, and are arranged to work in series, so that the total lift of the pump is the sum of the heads generated separately by each impeller. The water on leaving one set of guide vanes is led to the eye of the next disk by passages which have been carefully arranged so as to cause the water to move with as little friction as possible. The last impeller of the series delivers its discharge into an annular whirlpool chamber or diffuser, whence it passes into the delivery pipes. Owing to the impellers being of an unsymmetrical design, special precautions have to be taken to neutralise end-thrusts. With this object a balancing

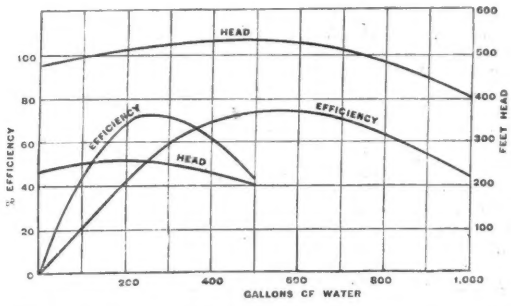


Fig. 6.—Graphical Record of Test, Allen Turbine Pump.

piston is fitted, the pressure on either side of the piston being so adjusted as to neutralise the unbalanced end-thrusts, and a small ball-thrust bearing is provided to take up any unbalanced end-thrusts which may arise during working, and also to register correctly the position of the impellers in relation to the casing.

All the bearings of the pump are of the self-oiling type, enabling the pump to run with the minimum amount of attention. The casing is provided with all the necessary accessories in the way of air vents to clear the pump of air when starting up. Great care has been taken in the design of these pumps to ensure smooth running, and to eliminate every possible cause of vibration, and with this end in view the greatest attention has been given to the balance and design of the spindle and the rotating parts carried by it.

Messrs. Allen have an excellent testing department, in

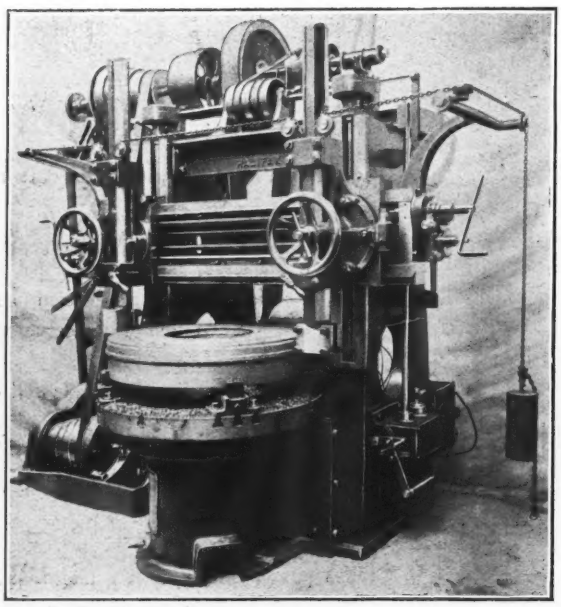


Fig. 7.—Electrically-driven Boring and Turning Machine, Olympia.

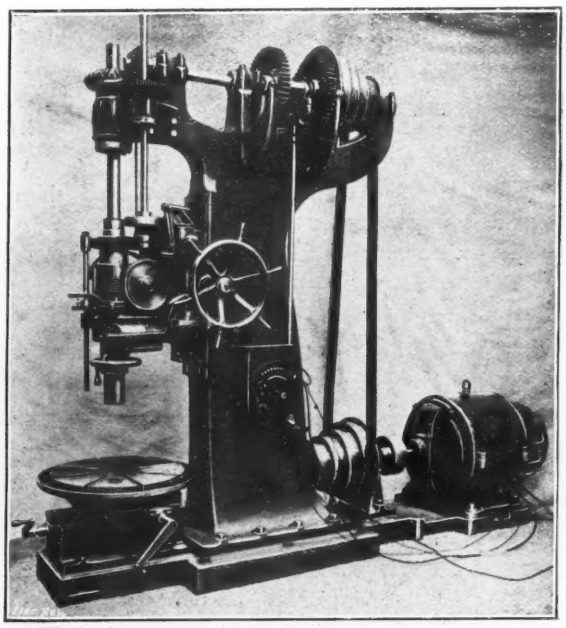


Fig. 8.—Electrically-operated Drilling Machine, Olympia.

which they have installed two Venturi water meters, the larger one being capable of registering up to 7,000 gallons of water per minute, and the smaller up to 850 gallons of water per minute.

Owing to the necessity for high speeds of rotation in this class of work, except in the case of belt or rope driving, special machinery is often required for driving purposes. In this connection Messrs. Allen are in an unusually fortunate position, having long been manufacturers of steam engines of the high-speed forced-lubrication enclosed type, which they have developed to a high degree of perfection, and which have been largely applied in the past in connection with pumping plants. They are also manufacturers of steam turbines and high-speed electric machinery, so that their customers have the great advantage of being able to obtain both the pump and prime mover from the same workshops, the design of each of which has been carefully adapted to the requirements of the other, thus ensuring a thoroughly satisfactory combination.

We publish a test sheet (fig. 6), showing graphically the performance of one of these pumps under varying conditions, which will give some idea of the thoroughness of the testing methods in vogue in Messrs. Allen's works.

SOME MACHINE TOOL EXHIBITS AT OLYMPIA.

The predominating feature of this year's display at Olympia is undoubtedly machine tools, and as they are of the foremost importance to all classes of engineers, some short reference to a few prominent examples will be of interest to our readers.

Messrs. J. Butler & Co., of Halifax, one of the best known of the Yorkshire tool firms, are showing several excellent specimens of the electrically-driven tool.

Prominent among these may be mentioned a 48-in. boring and turning machine (fig. 7) with a direct electrical drive. This class of machine is made in some ten different sizes by the firm, to turn from 30 in. to 12 ft. diameter. Among its advantages over the horizontal lathe, which have been fully appreciated by the majority of machinists, are its great accuracy, economy of floor space, time and labour. The 48-in. machine, which we illustrate, is of massive construction and provided with independent feeds to each tool bar, each having a separate speed box giving six changes of speed in either direction.

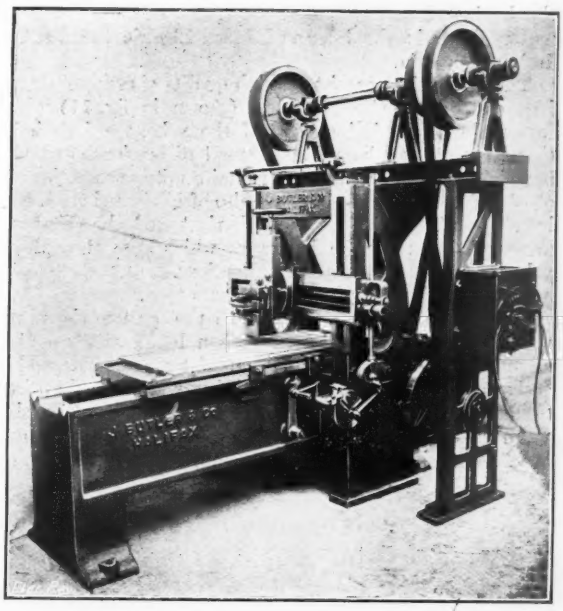


Fig. 9.—Electrically-driven High-speed Planing Machine, Olympia.

The driving is effected by a 15-H.P. constant-speed motor, fixed on the bed at the back, which is belted to the countershaft shown over the standards.

Some 15 speeds can be obtained through the speed cones and back gear.

Fig. 8 illustrates an electrically-driven high-speed vertical drilling and boring machine by the same firm. This machine is also of massive construction, the drill spindle being supported in a large steel sleeve with gun-metal liners and accurate ball thrusts at the top and bottom. Self-acting and slow hand feeds, also a quick hand adjustment and automatic trip motion are provided.

The machine is self-contained, the countershaft being fitted on the base and direct-coupled to an 18-B.H.P. variable speed motor. The machine will drill a $\frac{3}{4}$-in. hole through cast-iron at the rate of 20 in. per minute.

Messrs. Butler's other exhibits include a 10-in. slotting machine, with quick return motion, and driven by a 5-H.P. variable speed motor fixed on the base behind the machine; a 4 ft. × 2 ft. × 2 ft. high-speed planer, fitted with a self-contained countershaft and motor-driven (as illustrated in fig. 9); and a portable power drilling and tapping machine, shown in fig. 10.

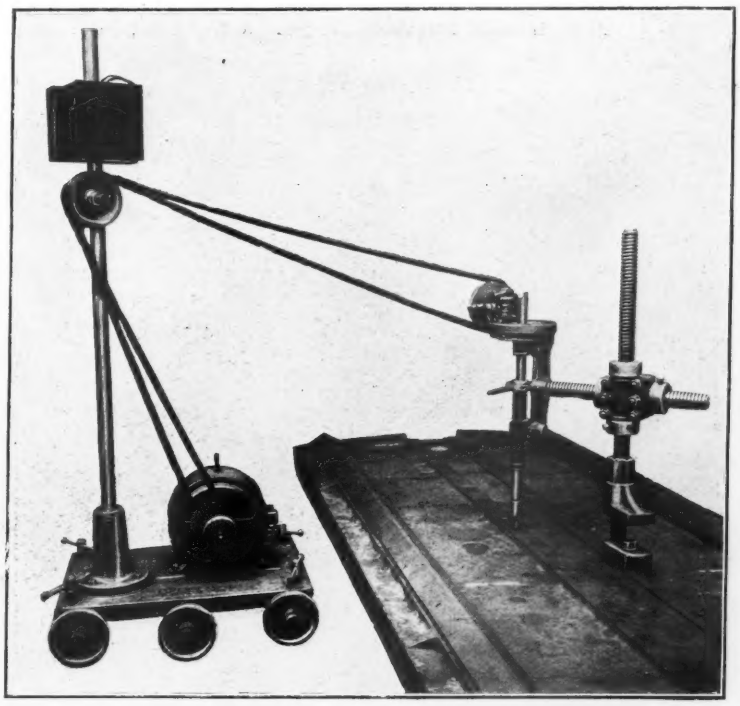


Fig. 10.—Portable Power Drilling and Tapping Machine, Olympia.

The latter machine consists of a drill-head supported by means of a couple of screws arranged at right angles. A connecting block between the screws enables the drill to be tilted to some extent and to be adjusted as to position. One of the screws is provided with a clamping foot, enabling the device to be attached to any convenient casting.

The drill is operated through a rope pulley, either from existing shafting or from a motor as shown. The makers supply a bogie for carrying the motor, &c., which is fitted with corner screws to give it rigidity when driving.

JOHNSON-LUNDELL DIRECT-CURRENT MOTORS AT OLYMPIA.

A somewhat novel feature in electric motor construction is the laminated steel yokes employed in the direct-current motors shown by the Johnson-Lundell Electric Traction Co., Ltd., at Olympia.

The laminations consist of high quality sheet-steel stampings cast into a skeleton frame (shown in fig. 11) which forms the mechanical support of the yoke, the idea being that the yoke can be made of small dimensions, and that the field acquires a degree of uniformity not otherwise obtainable. The pole-pieces are also of laminated steel, each held between end plates by a single rivet, and the pole-heads are coupled to the yoke by screws which pass through the yoke casing outside the yoke laminations.

The armature is of the slotted drum type.

These machines are fitted with the company's patent "Duplex" brush, in which the carbon brush unit is sectionally-divided and assumes the form of two semi-independent carbons with its sections arranged fore and aft in the direction of armature rotation. These move in independent slide ways at opposing angles, and are influenced by a self-balancing spring. They converge at a common point on the commutator and have the same area of contact as the single brush. The holders are mounted upon a common rocker arm, thereby affording means for adjusting the brushes to the neutral position and for accommodating them to the commutator wear (see fig. 12).

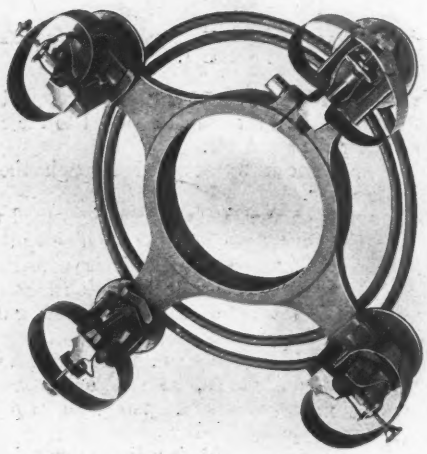


Fig. 12.—"Duplex" Brush Gear, Johnson-Lundell Motor.

The independence of the two sections of the brush effectively minimises the destructive sparking incidental to slight commutator inequalities by rendering an actual break of brush contact possible only through the coincident throwing off of the two sections, obviously a very unlikely occurrence.

One section of the brush carries a fine quality of soft carbon possessing the essential current-carrying capacity, and the other a harder quality affording the high contact resistance essential to minimising the arc consequent upon the momentary short-circuiting of two commutating segments. An unequal wear of these brushes ceases to be of consequence in view of their practical independence.

The advantages claimed, chiefly due to the above method of construction, are :—

1. Overall dimensions and weight for a given rated output less than any other machine at present made.
2. Sparkless commutation at all conditions of load up to 50 per cent. overload with fixed brush position.
3. Wide adjustment of speed by shunt control and standardised in the ratio of 1 : 3 *without the use of interpoles.*
4. Exceptionally high efficiency.

The above features render these motors particularly suitable for the direct driving of machine tools, printing machines, pumps, fans, &c.

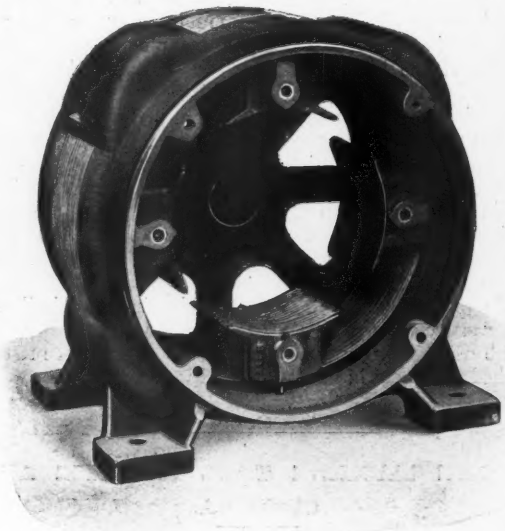


Fig. 11.—Carcass with Laminated Yoke, Johnson-Lundell Motor.

The company also builds D.C. dynamos and polyphase motors possessing the same features as mentioned above, the polyphase motors being fitted with ball bearings.

Field Telephones.—We recently mentioned the experiments carried out by Lord Kesteven with Lieut. Medhurst's new field telephone; we are now informed that this type of telephone has been manufactured by the International Electric Co. to Lieut. Medhurst's specification. A large number of them have already been supplied to home and Colonial troops, and are giving great satisfaction, notwithstanding the compactness and lightness of the whole outfit, which is about the size of a Kodak.

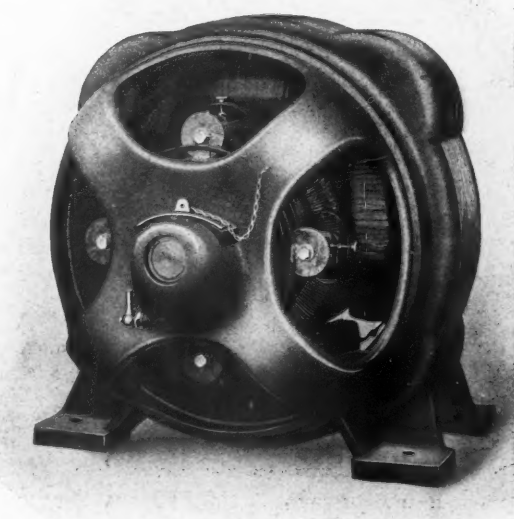


Fig. 13.—Johnson-Lundell Motor at Olympia.

The clear transmission of speech obtainable, and the distinctive signals that can be transmitted, combined with hitherto unknown portability, make the apparatus equally useful for colliery or traction work.

CONTRACTS OPEN.

(*Continued from page 570.*)

Belgium.—Brussels.—October 9th. The Telegraph Department requires tenders for cables, copper wire, galvanised iron wire, insulators, &c. Particulars, No. 194, may be obtained from the Directeur du Service des Télégraphes, Place de la Monaie, Brussels.

Bradford.—October 5th. Electric wiring installation, telephones, bells, at the Union Hospital, Horton Lane, Bradford. Clerk to Guardians, 22, Manor Row, Bradford (deposit £1 1s.).

Brussels.—(No date fixed.) The Molenbeck freezing works require tenders for a complete installation (Glaceries de Molenbeck prés de Bruxelles).

Cologne.—October 9th. The Telegraph Construction Branch of the Prussian Railways requires 40,000 tons bronze wire. Particulars may be obtained up to September 25th, for 6s. each, at the Hausverhaltung of the k. Eisenbahn Direction, Dornhof 28.

Egypt.—November 1st. The Alexandria Harbour authorities require tenders for the construction of an electric power station and for the following plant, to be worked by electric power: —Five transporters of large range; five ditto of smaller range; six cranes of 4 tons each; 36 cranes of 2 tons each; 25 capstans; cables, feeders, &c. Particulars may be obtained from the Directeur des Postes et Phares.

Grimsby.—October 21st. Switchboard panels for the Corporation electricity department. See "Official Notices" September 27th.

G.W. Railway.—October 22nd and November 12th. Stores, including a number of electric and telegraph sections, for one year. See "Official Notices" to-day.

Italy.—November 4th. The municipal authorities of Acireale, in the province of Catania, require offers for the installation and working of an electric lighting and power installation, for 30 years. The city will contribute £1,480 per year for 112,278 KW.-hours, and the company must deliver any further energy required for lighting at 3½d. per KW.-hour. A deposit of £160 is required. Tenders are to be made to the Sindreo, and the amounts and names are to be considered strictly confidential.

Limerick.—October 15th. Switchboard extensions for the Electricity Department. See "Official Notices" to-day.

L.C.C.—October 8th. Three electrically-driven boiler feed pumps (each 9,000 gallons per hour capacity) for the East Greenwich tramway generating station. See "Official Notices" August 30th.

Londonderry.—October 11th. Wiring and fitting the new Municipal Technical School for electric light, &c. Specifications, &c., two guineas. E. J. Toye, 20, Great James Street, Derry.

Manchester.—October 8th. Tenders are invited by the Corporation Tramways Committee for special (permanent way) trackwork in connection with their electric tramway system. Mr. McElroy, general manager.

Marylebone.—October 16th. Arc lamp carbons for the Electricity Department. See "Official Notices" to-day.

New Zealand.—December 11th. The Napier T.C. requires tenders for electric tramways, lighting and power supply. Frank N. Bower, Town Clerk.

Paris.—October 24th. The Municipal Waterworks Department (Service des eaux, canaux et égouts) requires tenders for the supply and erection at the Austerlitz works of (1) four sets of motor-driven pumps, dynamos, &c., complete, capable of lifting 100,000 cubic metres of water per day into either of two reservoirs, or 50,000 cubic metres into both at the same time; (2) and one reserve set; (3) 10 boilers in two groups of three, and one of four. Particulars may be obtained at the Hotel de Ville.

Southampton.—The Corporation requires sundry underground cables, conduits, and earthenware troughs. See "Official Notices" August 23rd.

Southampton.—Second-hand steam generator of about 200 KW., at 420-440 V., D.C., on loan, for the Corporation. See "Official Notices" September 20th.

Southampton.—Cables for the Electricity Department. See "Official Notices" to-day.

Spain.—Madrid.—October 15th. The Post and Telegraph Department require tenders for the exploitation during 10 years of the urban telegraph system of Sevilla. A royalty of 10 per cent. is required by the Government, also a bond of 20,000 pesetas. Particulars may be obtained advisably through an agent making personal application at the Direccion General de Correos y Telegrafos, 10, Carretas, Madrid.

Spain.—Madrid.—October 17th. The Post and Telegraph authorities require tenders for the exploitation of the Alicante telephone system. The bond is 10,000 pesetas. The remarks on the Sevilla tender apply also in this case.

Spain.—Madrid.—October 18th. The Post and Telegraph authorities require tenders for the exploitation of the urban telephone system of Valledolid during the next 10 years. A 10 per cent. royalty will have to be paid, and a deposit of 10,000 pesetas is required. Particulars may be obtained from the Direccion General de Correos y Telegrafos, 10, Carretas, Madrid.

Pontevedra.—October 29th. The municipal authorities require tenders for installation and working of electric lighting of the town &c., for 20 years. Particulars may be obtained from the Ayuntamiento Constitutional.

Toro.—October 30th. The municipal authorities require tenders for the installation, maintenance, &c., of public and private electric lighting for 10 years. Particulars may be obtained from the Ayuntamiento Constitutional, to which authority tenders are to be addressed.

Spain.—(No date fixed.) The Minister for Posts and Telegraphs requires tenders for the repairing of telegraph lines as follows:—

20	tons	galvanised	iron	wire	5	mm. diameter
20	„	„	„	4	„	„
4	„	bronze	„	2	„	„

Applications are to be made to the Direccion General de Telegrafos y Correos, 10, Carretas, Madrid.

Tunbridge Wells.—November 1st. 500-KW. turbine, alternator and exciter, surface condensing plant and pipe-work for Corporation electricity works. See "Official Notices" Sept. 27th.

Warrington.—October 22nd. Paper-insulated cables for the Electricity Department. See "Official Notices" to-day.

Willesden.—The District Council is to invite tenders for a second-hand electric crane; also for the supply of static transformers in connection with an extension scheme.

Wrexham.—October 22nd. One 50-KW. steam set for Electricity Department. See "Official Notices" to-day.

CLOSED.

Australia.—Melbourne.—The *British Australasian* states that the Postmaster-General has let a contract for 2,000 party telephone line registers to the International Electric Co., at £1,500.

Blackpool.—Messrs. Morrison & Roebuck, of Blackpool, have secured the contract for the electric light installation at the Alhambra Theatre, Brussels.

Bradford.—Mr. Chas. Pullan, of Bradford, has obtained the order to install electric light throughout the Muff Field Schools. The work will be carried out in steel conduit with the "Grip" system.

Burnley.—The Board of Guardians has just completed its yearly contracts, and among those accepted is Messrs. F. F. Thornton & Co.'s, for electrical requirements.

Clonmel.—Messrs. Newtons, Ltd., of Taunton, have received, through the Alliance Electrical Co., Dublin, the order for two generators required at the District Lunatic Asylum, Clonmel, Co. Tipperary.

Derby.—The T.C. has accepted the following tenders:—

Johnson & Phillips, Ltd.—Trunk mains, £688 10s.
Gilbert Arc Lamp Co.—20 arc lamps, £73.
Wm. Abell, Ltd.—Penstocks, screens, &c., at the E.L. station, £552.

Dover.—The Medway Motor Engineering Co., Ltd., Chatham, have secured the contract for the electrical installation at the new paper-mills at Buckland, Dover, for Messrs. Wiggins, Teape & Co., Ltd.

Glasgow.—The Trustees of the Clyde Navigation have accepted the following offers in connection with their Renfrew workshops:—

Cables.—Johnson & Phillips, Ltd., £810.
Switchboard.—Dorman & Smith, £364.

The Trustees have also accepted the offer by Siemens Bros. to supply a commutator grinding apparatus for Rothesay Dock at £56 10s.

Glasgow.—The Trustees of the Clyde Navigation have accepted the offer by the Post Office for a private telephone connection between the harbour office at Glasgow and the pilot station at Greenock, at £123 2s. 6d. per annum, and the offer by the National Telephone Co. for a connection between the harbourmaster's offices at Glasgow and Bowling at, £50 a year.

Glasgow.—In February last the Trustees of the Clyde Navigation resolved to procure two transporters of a suitable type for the ore traffic on the south quay of Rothesay Dock, and a committee was appointed to decide upon the type of transporter in order to admit of tenders being taken. Tenders were invited from several firms on general specification prepared by the mechanical engineer and the consulting electrical engineer. The tender of Messrs. Babcock & Wilcox, Ltd., was the lowest. The company submitted an alternative design of a patent transporter which commended itself to the committee. The committee accordingly went, along with the mechanical engineer, to see transporters of that design at work at Dagenham-on-Thames, and the members were satisfied that this transporter was exceptionally well adapted

for the handling of minerals, and they have now recommended the acceptance of the tender of the firm for two transporters, at £4,215 each.

Gloucester.—The T.C. has accepted the tender of the Sloan Electrical Co. for the supply of carbons for a year, at £133.

Leyton.—The U.D.C. last week received the following tenders for an oil eliminator for the generating station:—

Paterson Engineering Co., Ltd.	(accepted)	£160
William Boby..		181
Lassen & Hjort		195
Davis Perrett, Ltd.		260

The Council placed an order with Messrs. Frank Pearn & Co., at £90, for a Cameron pump.

London.—Bermondsey.—The B.C. has received the following tenders for cables:—

British Insulated & Helsby Cables, Ltd.—(1) 220 yards 7/18 twin lead-covered rubber cable, £23 15s.; (2) 110 yards 7/22 twin lead-covered rubber cable, £8 12s. 6d.; (3) 220 yards 7/16 three-core lead-covered paper cable, £24 7s.; (4) delivery, eight days.

Callender's Cable Co.—(1) £23 15s. 6d. (round); (2) £8 12s. 6d.; (3) £24 7s.; (4) 14-17 days, 1½ per cent. for payment within eight days.

Glover & Co.—(1) £24 7s. 8d.; (2) £8 16s. 11d.; (3) £24 16s.; (4) eight days, 2½ per cent. off rubber cable and 1½ per cent. in eight days.

W. T. Henley's Telegraph Works.—(1) £24 7s. 8d. (round); (2) £8 16s. 9d.; (3) £24 19s. 6d.; (4) 7-10 days, 2½ per cent. one month and 1½ per cent in eight days.

Johnson & Phillips (accepted for 1 (flat), 2 and 3).—(1) £21 8s. 5d. (flat), £24 7s. 8d. (round); (2) £8 16s. 11d.; (3) £24 7s.; (4) 17 days, 2½ per cent. rubber cable.

Siemens Bros. & Co.—(1) £21 8s. 5d. (flat), £24 7s. 8d. (round); (2) £9 8s. 4d.; (3) £24 7s.; (4) 1-2 weeks, 2½ per cent. rubber cable and 1½ per cent. in eight days.

Southwark.—The E.L. Committee received 13 tenders for the supply of 5,000 tons of coal for use at the generating station, and has decided (subject to the sanction of the Council) to accept the tender of Charrington, Sells, Dale & Co. for the supply of West Hallam Nutty Slack at 13s. 11d. per ton, delivered at the works in Penrose Street.

Poplar.—The Electricity Committee has accepted the tender of the British Westinghouse Co. (the lowest received), at £243, for switch panels and instruments at the southern sub-station.

Manchester.—The undermentioned tenders have been accepted by the Tramways Committee:—

F. Smith & Co., Salford.—Six miles of copper trolley wire.
Thermit, Ltd.—Supply of welding portions.

The following tenders have been accepted by the Electricity Committee.

W. T. Glover & Co., Ltd., for high-tension cables.
British Westinghouse Co., Ltd., and Ferranti, Ltd., for transformers and switchboards respectively, on consumers' sub-stations.
J. H. Billings & Co., for the foundations, &c., required for a 6,000-kw. turbo-generator at Stuart Street station.
Veritys, Ltd., Reyrolle & Co., Ferranti, Ltd., and Siemens Bros. Dynamo Works, Ltd., for direct-current motor starters until June 30th, 1908.
British Thomson-Houston Co., Ltd., for incandescent lamps as required until June 30th, 1908.
The General Electric Co., Ltd., Electromotors, Ltd., the British Westinghouse Co., the Lancashire Dynamo and Motor Co., Ltd., Siemens Bros. Dynamo Works Co., and Laurence, Scott & Co., Ltd., for supplies of direct-current motors till June 30th, 1908.

Oldham.—Thermit, Ltd., have obtained an order from the Corporation Tramways Department for one of their portable rail grinding equipments (Mattinson's patent).

Warrington.—An order has been placed with Messrs. Davidson & Co., Ltd., of Belfast, for a "Sirocco" induced-draught fan and engine to be installed in the Warrington Electricity Works. The fan will measure 60 in. in diameter, and will be capable of dealing with the products of combustion of 11,500 lb. of coal per hour.

Wimbledon.—The T.C. has accepted the tender of Stuart & Moore to erect and maintain for seven years six "Pendulum" fire-alarm transmitters, of type "B," in their new pattern fire-alarm posts, connected by separate single overhead wires to receiving apparatus at the central fire station, at £72 per annum, the fire alarms at the end of the seven years to become the absolute property of the Council.

CONTRACTORS' COLUMN.

Openings for New Business.

ABOYNE (N.B.).—New Episcopal Church of St. Thomas.

ASHBOURNE.—New building in connection with Queen Elizabeth's Grammar School in Green Road (£10,000).

BARGOED.—Addition and alteration to premises for New Tredegar Co-operative Society, Ltd. Apply Committee, Co-operative Society, Ltd., 56, Commercial Street, New Tredegar.

BARTON, WHIPPINGHAM (I.O.W.).—Isolation hospital at Royal Naval College, Osborne.

BATH (Radstock).—Extensions to the British Wagon Co.'s works. F. Cartwright, surveyor, 15, North Church Street, Sheffield.

BEDFORD.—Additions to works for the Adams Manufacturing Co., Elstow Road, Bedford, owners.

BERWICK-UPON-TWEED (Paxton).—New United Free Church. Grey and Boyd, architects, Berwick.

BIRMINGHAM (Sparkbrook).—New Congregational Church (£2,850). Rev. T. Towers, pastor.

(New Warley).—Establishment of model village. W. H. Hughes, 9, Ludgate Hill, Birmingham.

BLACKBURN.—New gymnasium, lit by electricity; gift of Alderman H. Harrison. Sames & Green, architects, 14, Richmond Terrace, Blackburn.

BOLTON.—New shops in Newport Street for L. and Y. Railway. Secretary L. & Y. Railway Co., Hunt's Bank, Manchester.

Additions to premises in Bridge Street for Local Co-operative Society.

Rebuilding the Fleece Hotel for J. Sharman & Sons, brewers, Bolton.

BRAINTREE (Bocking).—Extensions at the Council School (£1,719).

BRIDGEND (Bryncethin).—Coke ovens and coal-washing plant (£70,000). Copper Coke Ovens Co., owners.

BRIGHOUSE.—New secondary school for girls for the T.C. (£10,000).

BURGESS HILL (Sussex).—New Vicarage in Park Road. W. J. Gibbon, architect. S. Packham, builder, Burgess Hill.

CALNE (Wilts.).—Converting Lansdowne Villa into school. Henry Beck, architect, 10, High Street, Burton-on-Trent.

CARDIFF (Ely).—General stores for Llandaff and Dinas Powis R.D.C. J. Holden, surveyor, 20, Park Place, Cardiff.

CAMBRIDGE.—E.L. and power plant at Fulbourn Asylum (£5,000).

Business premises and warehouse in Market Hill and Petty Cury. Hallack & Bond, Ltd., Petty Cury, Cambridge, owners.

CHELMSFORD.—Extension of the isolation hospital for the B.G. (£2,500). W. H. Pertwee, architect.

CHELMSFORD.—Block of shops and houses in Duke Street. T. J. D. Cramphorn, Chelmsford, owner.

CHORLEY.—New corn mill in Houghton Street. R. and T. Hoole, owners.

CHURWELL.—New Wesleyan Sunday School at Back Green (£2,000).

CLEADON (Co. Durham).—New school for the C.C. J. H. Morton, architect, 50, King Street, South Shields.

COLNE.—New place of worship (£3,900). Holgate & Spivey, architects, 4, Dockray Street, Colne.

CORSHAM (Wilts).—Villa residence for W. James Bromley, Doncaster. W. H. Bromley, architect, Pickwick Road, Corsham.

COVENTRY.—Important additions to works in Sandy Lane. Daimler Motor Co., Ltd., owners.

Factory at Hill Top. Triumph Cycle Co., Ltd., owners.

DEAL.—Swimming and other baths, concert hall and bungalows (£10,000). Apply to Councillor H. Barron, Deal.

DUKINFIELD (Lancs.).—New Sunday School in connection with Foundry Street church.

DUDLEY.—New public library for the T.C. G. H. Wenyon, architect, Tipton.

Printing works and offices for *Dudley Herald*, Ltd. Walter Wright, architect, 28, Wolverhampton Street, Dudley.

(Netherton).—New Church Schools. Mr. Grazebrook, architect; Wm. Deeley, builder, Dudley.

DUNDEE.—New school, to cost £15,000. James Langlands, architect, Dundee.

EAST PLEAN (Stirlingshire).—School extension, costing £3,000. MacLuckie and Walker, architects, Stirling.

ESSEX.—Proposed new infirmary at Lexden and Wenstree Workhouse (£1,600).

EXETER.—Factory (£1,565). Westcott, Austen & White, builders, Summerland Crescent, Exeter.

FALLIN (Stirlingshire).—New church. MacLuckie & Walker, architects, Stirling.

FENTON (Staffs.).—Important additions to old Foley Pottery. Jas. Kent, Fenton, owner.

FOLKESTONE.—Bank premises in Sandgate Road for the London and County Banking Co., Ltd.

FRIZINGHALL (near Bradford).—New Sports Pavilion for the Bradford Grammar School. Adkin & Hill, architects, Bradford.

GERRARDS CROSS (Bucks.).—Block of shops in Pack Horse Road. H. Brown, owner.

GLASGOW.—New Jerusalem Church in Woodlands Road.

GORLESTON.—Repairs, &c., to the Odd Fellows' Hall in High Street. Write G. A. Woods, 91, Lower Clift Road, Gorleston.

NEWPORT (Mon.).—"Happy Family" Inn to be rebuilt.

GRAVESEND.—Extensive additions to the South-Eastern and Chatham Railway Station.

HANLEY.—Offices and residences for the National Amalgamated Society of Male and Female Pottery Workers. Wm. Campbell, architect, 103, Victoria Road, Hanley.

HANWELL.—Conversion of larger house, lately occupied by B. J. Willats, to Convent.

HARWARDEN.—Hospital for the R.D.C. J. H. Davis & Sons, architects, Chester.

HEANOR (Marlpool).—New Church (£3,800). Naylor & Sale, architects, Iron Gate, Derby; Mr. Duron, builder, Marlpool.

HIGH WYCOMBE.—New Council Schools for T.C. (£7,600).

HUDDERSFIELD (Scammonden).—New co-operative premises and house at Pole Moor. J. Berry, architect, 3, Market Place, Huddersfield.

IPSWICH.—Important extension of Britannia Road Schools (564 seats) for the T.C. J. H. Hume, secretary to the Education Committee, Ipswich.

KETTERING (King's Sutton).—New Elementary School for Northhants C.C. J. T. Blackwell, architect, 53, High Street, Kettering.

LEEDS (Roundhay).—Pair of houses in Street Lane. W. H. Beevers, architect, 25, Bond Street, Leeds.

LITTLE HULTON.—Enlargement of Worsley Road British School. Write Secretary Education Committee, Kearsley, Lancs.

LONDON (Cricklewood).—Baptist Church in Anson Road (£6,000). Arthur Keen, 4, Raymond Buildings, Gray's Inn, W.C., architect.

(Bermondsey).—Extension of factory for the London Metallic Capsule Co., Rotherhithe Street. A. White & Co., 82, Paradise Street, S.E., builders.

(Bermondsey).—Mustard mill in Rotherhithe Street for C. Barry and Co. Perry Bros., 11-12, Finsbury Square, E.C., builders.

(W.C.).—Alterations and additions to premises of the Daimler Motor Co., Ltd., in Theobald's Road. Brient & Son, 200, Kennington Park, S.E., surveyors.

(Westminster).—Shop in Victoria Street. Z. King & Son, 171, Victoria Street, S.W., architects.

(Fulham).—Buildings in Colehill Gardens. A. Blackford, 61, Chancery Lane, W.C., architect.

(Greenwich).—Additions and alterations to buildings for Moore, Nettlefold & Co., glass bottle makers. J. O. Cook, 2, Wrottesley Road, Plumstead, S.E., architect.

(Bloomsbury).—Enlargement of County Court. H.M. Office of Works, Storey's Gate, S.W.

(Brixton).—The name Spiers & Pond given in the item under this heading last week should have been printed Spiers & Porri. The address is 2, Hill Road, St. John's Wood, N.W.

(W.).—Alterations to 22, Regent Street, for Elkington & Co., manufacturing silversmiths. Killby & Gayford, 97, Worship Street, Finsbury, E.C., builders.

LONDON.—(Walthamstow).—Alterations to "The Windmill" public house. Green & Smith, 357, Seven Sisters Road, N., builders.

(Willesden).—Alterations to premises for the Simms Manufacturing Co. J. B. Merson, 76, High Road, Kilburn, N.W., architect.

(Cricklewood).—House in Sheldon Road. S. and E. Banks, 163, Cricklewood Broadway, surveyors.

(Willesden Green).—Additions to laundry. Freeman & Barber, Ashford Road, N.W., builders.

(Walthamstow).—Public house in Lea Bridge Road. W. Bradford and Sons, 12, Regent Street, W., architects.

(Leyton).—Alterations and additions to "Elms" public house. H. G. Needham, 16, St. Helens Place, E.C., architect.

(Bermondsey).—New hall of the Grange Mission, Abbey Street. Electric light to be installed.

(Brixton).—Buildings in Acre Lane. F. J. Eedle & Myers, 8, Railway Approach, London Bridge, architects.

(Walworth).—Parochial hall in Surrey Square. J. E. K. & J. P. Cutts, 14, Southampton Street, Strand, W.C., architects.

(Wandsworth).—Buildings in Garratt Lane. H. Bignold, 67, Battersea Rise, S.W., architect.

(W.C.).—Building in Adelaide Place. R. T. Wreathall, 5, St. Martin's Place, W., surveyor.

(Southwark).—Additions to convent of Notre Dame. J. C. Radford, 189, Upper Richmond Road, Putney, S.W., architect.

LLANDRINDOD WELLS.—Additions and alterations to Gwalia Hotel. A. Swash, architect, Midland Bank Chambers, Newport, Mon.

LLANISHEN.—Lodge, stables and motor house for W. Lloyd. G. E. Halliday, architect, 19, Castle Street, Cardiff.

LOCHGELLY (Fife).—Railway station extensions for North British Co.

New Town House (£3,000). J. T. Scobie, architect, Dunfermline.

MAIDSTONE.—New theatre on Gabriel's Hill. Maidstone Theatre and Palace of Varieties Co., owners.

New premises in Knightrider Street for the Church Army Home.

Extensions at H.M. prison. Barden & Head, builders, Maidstone.

MANCHESTER.—Sixteen houses for the Radcliffe and Pilkington Co-operative Society, Sion Street, Radcliffe.

(Chorlton-cum-Hardy).—New Presbyterian Church. Rev. Dr. De Vlieger, minister.

MANSFIELD (Langwith).—Ammonia and tar works. Sheepbridge Coal and Iron Co., Ltd., owners.

MERTHYR TYDFIL (Pentrebach).—New public hall. Ben Evans, architect.

METHIL (Fife).—Twenty houses and shops for Methil Land Investment and Building Co. Mr. Murray, Kirkcaldy.

MONTROSE.—Institute for Young Men's Christian Association. Pert & Sons, builders, Montrose.

NELSON (Lancs).—Weaving shed for Messrs. Townsley Bros.

NEWLYN (Cornwall).—New harbour offices. W. T. Douglas, engineer to the Harbour Commissioners, 15, Victoria Street, S.W.

NEWPORT (I.W.).—Isolation hospital for the Isle of Wight R.D.C.

NEWPORT, MON. (Blackwood).—New collieries at Oakdale. Walker and Harrison, contractors.

(Sirhowy Valley).—Opening of new collieries electrically equipped. Partridge, Jones & Co., Llanhilleth Collieries (Mon.), owners.

NEW TREDEGAR.—New premises for New Tredegar and District Co-operative Society, Ltd. Apply Committee, Co-operative Society, Ltd., 56, Commercial Street, New Tredegar.

NOTTINGHAM (Bingham).—New Council schools for Notts C.C.

PANNAL (Yorks.).—Residence, stabling, motor garage and lodge. T. E. Marshall, architect, James Street, Harrogate.

PERTH.—Extension to premises for John Dewar & Sons, distillers, in Glasgow Road.

Completion of St. Ninian's Cathedral, and new Chapel in connection with same.

PORTSMOUTH.—New Nursing Sisters' quarters at Alexandra Hospital, Cosham. H. B. Measures, Director of Barrack Construction, War Office, Pall Mall, S.W.

Rebuilding out-patients' department of the Royal Portsmouth Hospital (£4,000). Write, Governors of the Hospital.

PORT TALBOT.—Houses (100), main offices, villas, &c., for Whitworth Collieries, Ltd., Port Talbot. R. O. Clark, architect, Port Talbot.

PRESTON.—New elementary school in Deepdale Road for the T.C. (£12,500).

New school in St. Stephen's Road. Education Committee, Preston.

PRESTWICK (N.B.).—New Established Church (£5,000).

REDHILL.—Girls' secondary school for Reigate T.C.

Important extensions at the Parish Church (£3,000). Rev. F. C. Davies, vicar.

RHAYADER (Radnorshire).—School, house, offices, workshops, &c., for Birmingham T.C. in connection with the Elan Valley Water Works. H. T. Buckland, architect, Norwich Union Chambers, Congreve Street, Birmingham.

SALFORD.—Extensions to Messrs. Jones's dyeworks.

SCARBOROUGH.—Reconstruction of St. Mary's School (£1,000).

SHOTLEY.—Important extensions at Shotley Naval Barracks (£9,500).

SITTINGBOURNE (Teynham).—Residence. R. Lake, owner.

SOUTHEND-ON-SEA.—New hall in Bournemouth Park Road in connection with St. George's Presbyterian Church,

STIRLING.—New Corporation slaughter house. Master of Works, Stirling, architect.

New villas at Bellfield for Mr. Somerville, manufacturer, St. Ninians. Builder, R. Reid, St. Ninians.

SUNDERLAND.—Extensions at the workhouse (£10,968). W. & T. R. Milburn, architects, 20, Fawcett Street, Sunderland.

SWANSEA.—New colliery on the Town Hill Estate. Town Hill Colliery Co. (J. W. Innes, managing director) owners.

Coach and Horses Inn to be rebuilt. Hancock & Co., Ltd., Little Wind Street, Swansea, owners.

SWORDS (Co. Dublin).—New Carnegie Free Library. A. Scott, architect, 34, Lower Sackville Street, Dublin.

TREDEGAR (Bedwellty).—Business premises in High Street, Fleur-de-lis. John Davies, Coal Hole Inn, Gellihaf, Maesycwmmer, owner.

TRURO.—Extensions to bank premises in King Street. Barclay & Co., Ltd., owners.

TWICKENHAM.—New theatre in Heath Road. A. C. Feio.

WENTBRIDGE (Yorks.).—Mixed school. Tennant & Collins, architects, Pontefract and Barnsley.

WILLENHALL.—New elementary school (£4,141) for the managers of St. Giles's Schools.

WILMSLOW (Cheshire).—Extensions and improvements at L. & N.-W. Railway Co.'s station.

WIMBLEDON.—Additions to Sandbrook Villa, Kingston Road. R. A. Hinds, Wood Nook, Wimbledon Hill, architect.

Eleven houses in Melrose Avenue. Charles Barwell, Wimbledon.

Three houses in Kenilworth Avenue. Boyton, Sons & Trevor, Broadway, Walham Green, surveyors.

Motor garage and coach works in Gladstone Road.

WIMBLEDON.—Alterations and additions to South Park Laundry, 204, South Park Road.

YEOVIL.—Cookery room and laboratory at the Girls' High School. J. N. Johnson, architect, 21, Princes Street, Yeovil.

WINDERMERE.—Residence on Rayrigg Estate. J. Stalker, architect, 57, Highgate, Kendal.

FORTHCOMING EVENTS.

Engineering and Machinery Exhibition at Olympia. Open until October 19th

TO-DAY (Friday, October 4th).—At 8 p.m. At Holborn Restaurant (King's Hall). Electro-Harmonic first smoking concert for the season.

Monday, October 7th.—At 7.30 p.m. At the Royal United Service Institution, Whitehall. Ordinary meeting of the Society of Engineers. A. S. E. Ackermann, chairman.

Thursday, October 10th.—At 7.30 p.m. At the Colonnade Hotel, Birmingham. Monthly meeting of the Birmingham and District Electric Club. Paper on "The Possibilities of Electrical Development," by R. Borlase Matthews.

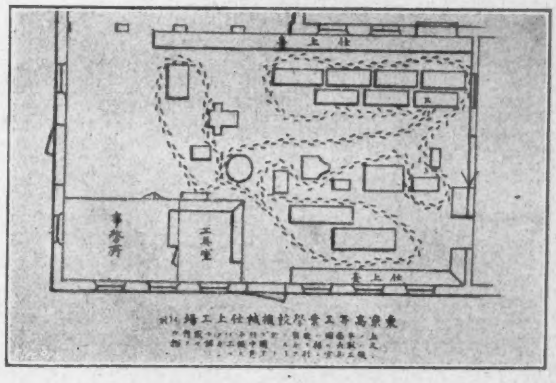
Thursday, October 17th.—Rugby Engineering Society. Lecture by Mr. E. R. Briggs (past-president) on "Steam Turbines, with special reference to the Willans-Parsons type."

Friday, October 18th.—At 8 p.m. At Institution House, Storey's Gate, St. James's Park. Monthly general meeting of the Institution of Mechanical Engineers. Paper on "The Indicated Power and Mechanical Efficiency of the Gas Engine," by Prof. B. Hopkinson.

NOTES.

Appointments Vacant. — Switchboard attendant for Darwen Corporation (£52); borough electrical engineer for Limerick Borough (£160); switchboard attendant for Kirkcaldy (25s.).

Apprenticeship Systems.—*Lantern Slides for Shop Instruction.*—Whilst a great deal has lately been written and spoken as to the best system of apprenticeship, and the best methods of teaching apprentices their work, it cannot be said yet that any finality has been reached, nor any system proposed which can be adopted as a standard for all trades. It is, however, generally agreed that the old-fashioned long-term apprenticeship has had its day, and that under modern conditions of shop practice a shorter term of apprenticeship coupled with systematic technical and trade instruction form together a better training for workmen learning mechanical trades. As to the nature and extent of the technical training, there is still considerable divergence of opinion, and



Steps Taken to Find a Wrench.

whilst some manufacturers have their own teaching staff and trade schools, which the apprentices must attend, others rely upon the local technical institutes, leaving it to the apprentice to choose his own course of instruction.

Bearing on this question, an interesting article by Charles A. Francis appears in a recent issue of the *American Machinist*. As a result of a conversation which he had with the director of the Tokyo Koto Kogyo Gakko as to the training of Japanese workmen, the question of making use of lantern slides was discussed. As a result, a set of slides were prepared with a view to showing the mistakes made commonly by workmen and also the features which distinguish the good workman from the bad. Some of these slides illustrate sayings by Van Dervoort in his book entitled "Modern Machine Tools." Some of the sayings illustrated are the following:—

"The lathe bed must not be used for an anvil, nor yet as a resting place for tools, wrenches, chucks, &c. Have a shelf or tool rack for this purpose." The slides illustrating this saying show a lathe bed very badly marked and dented, from which it can be seen at once that the lathe has certainly been used as an anvil.

On another slide a lathe bed is shown littered with spanners, cutting tools and other miscellaneous articles, whilst others by way of contrast show a lathe provided with a tool box or cabinet in which all the tools are neatly arranged, those in use being placed on a shelf above the tool drawer.

Another saying, "A good machinist never ill-treats his lathe, and always keeps it clean, tidy and well adjusted," is illustrated by means of a slide which shows a drill press table which is disfigured

all over with the marks of the drill. It is explained by the author that whilst looking through the machine shops in Tokyo he saw a drill press that had a table marked even worse than the one shown in the photograph (which is a bad specimen), and was informed that that table was the third that had been made for the machine, owing to the abuse to which the machine tools were subjected.

Another slide shows the difference between a good and a bad screw-driver, from which it is very plain why the slots of screws are often burred and spoilt.

A further slide shows a set of centre punches, some of which are accurately pointed and others in which the points are either dull or bent. The holes made by these punches are also shown, from which it is easily seen how the accuracy of the work is affected by a badly ground or worn punch.

Other slides show work bruised by dogs, twist drills bent by the same means, and also the effect of dirt on the drill. This photograph shows a shadow round the drill which indicates that it is running very considerably out of truth.

Two slides are used to show the time often wasted by youths and workmen in looking for tools. In one of these slides, which is reproduced on p. 577, a plan of a corner of the machine shop is shown, and it is supposed that the workman in charge of the lathe at "X" has lost his wrench. The dotted line is intended to show the footprints made by the man in trying to find the wrench. His path round the various machines in the shop can be easily traced.

To contrast with this, another slide is shown in which the wrench is attached by a small chain to the lathe so that *it will not walk away.*

Many other illustrations are given, but the above will be sufficient to indicate the chief purport of the slides which, although drawn up for the benefit of Japanese workmen, contain lessons which may very well be taken to heart by young workmen in this country.

Society of Engineers.—By kind permission of the Admiral Superintendent Vice-Admiral G. A. Giffard, C.M.G., a party of about 40 members and friends of this society paid a visit to Chatham Dockyard on September 25th. The party was under the leadership of Mr. J. W. Wilson, the president-elect of the society, and of Mr. A. S. E. Ackermann, the newly-appointed secretary. Before the lunch interval in the middle of the day, the departments visited were chiefly electrical. The inspection was prefaced with a description of the various safety devices in use in the firing of big guns which ensure that the circuit cannot be completed until after the breech block is properly home, followed with a demonstration of the hardening of tool steel by a method described at the New York meeting of the Iron and Steel Institute about two years ago. The tool is held with its point immersed in a bath of potassium carbonate and water, and a direct current is passed from the tool to the bath. The tip becomes heated, current is switched off, and the tool is quenched at the critical moment. Next followed a demonstration of the softening of the case-hardened surface of armour plates by a low-voltage alternating current passing between two copper terminals pressed against its surface. Proceeding through the electrical repairing shop (where evidence existed that most of the repairs were being executed upon motors of ancient patterns) a visit was paid to the generating station. This bears a close resemblance to that at Portsmouth Dockyard. Seven 500-KW. 440-volt D.C. shunt-wound Bruce Peebles generators are direct coupled to Belliss & Morcom engines. The various motors are connected across the outers of a three-wire network, lamps being connected between the middle and outer wires. Motor-driven balancer sets and boosters are provided. Steam is generated in dry-back marine boilers, with Bennis stokers, and a McPhail & Simpson independently fired superheater is provided as well as Weir feed pumps. The coal-handling and weighing apparatus is of the best modern description.

The afternoon's visits commenced with a tour through the "fine collection" (our guide's appellation) of machinery in the machine shops. They are electrically driven it is true, but we have never seen the electrical operation of machine shops undertaken in such a half-hearted way, or group-driving carried out with a greater elaboration of superfluous shafting and labyrinths of belting. Thereafter followed visits to foundries, pumping stations, and so forth, winding up with a battleship. The party divided, some going to H.M.S. *Black Prince* and some to H.M.S. *Swiftsure.* After a warm, but interesting day, the party returned to town.

Co-operation between Manufacturers.—Bearing on the question of co-operation, a subject which has been much to the front of late, an article appears in the August issue of *Cassier's Magazine*, by J. F. Gairns, entitled "Working Agreements between Manufacturers." The author considers that the day of the small manufacturer as a prominent feature of industry passed away with the nineteenth century, the present century being characterised by combinations of what were previously independent firms into groups or "combines" for the purpose of cheapening production and for mutual protection. In the case of a "combine" there is usually now a single controlling central body, which has the power of over-ruling the individual controlling bodies. Any agreements entered into between such combining firms or companies are, therefore, more in the nature of working arrangements between the components of a complete concern rather than arrangements between independent firms.

Between independent firms, however, working arrangements may be arrived at to control the prices of products, or to limit the operations of individual firms, such, for instance, as the limiting of one firm to supplying the raw, or partially prepared, material to other works, where the finished product is turned out. Other agreements are for the purpose of enabling large orders to be taken which are beyond the capacity of a single firm. Agreements are sometimes made between two or more firms for the purpose of competition with trade rivals. These various arrangements are discussed by the author, who points out that under a system of combination, firms which are separated geographically by long distances, but are producing similar articles, can reduce the expenses of travellers, showrooms, branch offices, &c., by arranging to supply only within a given radius of their own works, inquiries from other localities being executed by the combining firm in that locality on behalf of the firm to whom the inquiry has been directly sent.

In some industries it is only the large firms that can carry out the complete manufacture of the finished article. An instance of this is provided in the organ building trade, where agreements are made with firms concerned with sectional manufacture to supply their productions to other firms, which carry the manufacture a further step, or to a firm selling the finished article. Thus it is said that many firms who supply organs are little more than organ builders and tuners, such parts as keyboards, cases, bellows, wood pipes, metal pipes, mechanism, pedal boards, leathers, pallets, and almost all the individual parts being obtained from smaller manufacturers, each specialising in one or two of the items.

Touching on the question of large orders, it is pointed out that sometimes these are beyond the capacity of any but the very largest firms; or, in other cases, the conditions of payment are such that smaller firms cannot very well undertake them. It is suggested that a convenient way of overcoming these difficulties is for a syndicate of firms to combine for the purpose of obtaining larger orders than they can deal with individually, such firms dividing the work, expense and profit by some suitable arrangement. In such cases, one firm or person generally represents the syndicate for the obtaining and execution of the work. It is argued that such mutual arrangements as are described would be an effective answer to the pressure of capital, trusts and combines, which form a growing feature of our present-day manufacturing industry.

Electricity and Blast-Furnace Gases in Austria.—Among the papers of immediate local interest presented to the Iron and Steel Institute at their Vienna meeting was that by Wilhelm Kestranek on "The Austrian Iron Industry during the Last Twenty-Five Years." From it we abstract the following notes:—

Visitors would find everywhere the most extensive application of electricity, mostly in conjunction with blast-furnace gas engines, and also coke oven gas engines for the generation of power, and, as an example, in Witkowitz a plant of this description of 5,700 horse-power exists.

It should here be noted that at the Austrian blast-furnaces which yield 790,000 cubic metres of gas per hour, 263,000 cubic metres are used for blast-heating, so that 527,000 cubic metres are available. Of this quantity at the present time 358,000 cubic metres, or 68 per cent., are utilised for boiler-heating, and 34,000 cubic metres, or 6·5 per cent., representing 12,000 horse-power in gas engines, whilst the remainder of the gas is used partly for ore roasting or in drying kilns, and partly drawn off unutilised. The Bohmische Montangesellschaft, which at present is utilising blast-furnace waste gases on the most extensive scale, utilises 23 per cent. of the available gas in gas engines.

In the Austrian coke works, the coke ovens yield 86,000 cubic metres of gas per hour, of which quantity the coke ovens themselves absorb 62,000 cubic metres, so that 24,000 cubic metres are available. Of this quantity 5,700 cubic metres, or 24 per cent., are utilised in gas engines, whilst the remainder is used for boiler-heating.

The most complete application of electricity to the driving of rolling mills was shown to the members in Teschen, where not only the finishing, intermediate, and roughing trains, but also the reversing rolling mills are driven by electric motors. As early as 1897, in Servola, Trieste, the Krainische Industrie-Gesellschaft at their blast-furnace plant installed an electric ship-loading crane to serve a blast-furnace with a daily output of 250 tons.

The Austrian steel works engaged in the manufacture of alloy steels of great value, specially tool steel, have also lately adopted the new electric processes. Thus the Poldihutte have adopted the Kjellin process, the firm Gebrüder Bohler & Co. are introducing the Ch. A. Keller electric arc process, and the new Styrian cast-steel works of Danner & Co. employ the Heroult process; the Karntnerische Eisen- und Stahlwerke have also decided to adopt the Heroult process at their works in Ferlach.

Conciliation in Trade Disputes.—The sixth report of the Board of Trade on the proceedings under the Conciliation (Trade Disputes) Act, 1896, has been issued, dealing with the two years ended with June 30th, 1907. The number of cases concerned was 51, of which 45 were settled under the Act, as compared with 27 and 24 in the two preceding years respectively. Only two or three cases referred to are of electrical interest. In the first instance, the report refers to the strike in September, 1906, of the bodymakers, finishers and painters at the Loughborough Works of the Brush Co. It is mentioned that the conference held between the parties did not result in a settlement of the dispute, and that the men on strike have been replaced by others. The second case relates to the Manchester tramway men and the payment for Sunday labour. It appears that a joint application was made to the Board of Trade in April, 1906, by the Tramways Committee of the Manchester Corporation and their employés (represented by the Amalgamated Association of Tramway and Vehicle Workers) for the appointment of an arbitrator to settle the difference. The question submitted to arbitration was as to whether the drivers, guards, time-keepers and inspectors were reasonably entitled to payment of time and a half for all Sunday labour, having regard (1) to the concessions granted by the Committee in the past; (2)

to the existing wages and working conditions as compared with those obtaining on other tramways; and (3) to such other facts and arguments as might be put forward by either party in support of or against the proposal. The Board of Trade appointed Mr. G. R. Askwith to act as arbitrator. The decision arrived at by him was that if the concession asked for was granted, not only would a heavy charge be entailed upon the ratepayers, but also the employés, in addition to the present high rates of wages paid to them, and the previous concessions granted to them from time to time, would receive a benefit out of the undertaking quite out of proportion to that to which they were reasonably entitled. The arbitrator consequently awarded and declared that the claim, unless the rates of wages and working conditions were revised, could not justifiably be granted, however desirable it might be on general principles, that facilities should be afforded for releasing employés from work on Sundays. In connection with the strike last January at certain London music halls, the final award of Mr. Askwith fixed 30s. per week as the minimum wages for electricians (switchboard attendants). At the same time, the arbitrator stated that the variety in the extent of electrical knowledge and skill in dealing with electrical appliances required for different theatres of varieties is so large that no dividing line between electricians (qualified switchboard attendants) and electricians paid under the title of "chief electricians" or "master electricians" can be fixed for the purpose of gradation of minimum wage, and in his opinion no minimum wage for such chief or master electricians is required. The report further shows that a conciliation board exists at Birmingham between the Gas and Electric Light Fittings Employers' Association and the Master Brassfounders' Association and the National Society of Amalgamated Brassworkers. An extract from the agreement provides that should the two secretaries declare a question contentious, only an equal number shall take part in the voting. Any matter which cannot be amicably settled by the board is to be referred to the Board of Trade, to be dealt with under the Conciliation Act. A conciliation board also exists in connection with the Huddersfield Corporation Tramways. One of the rules (No. 12) provides that the board shall elect as president an independent person from outside, but failing election by the unanimous vote of the members of the board, the Board of Trade is to be asked to nominate a president, whose nomination shall, however, be subject to confirmation by a majority of the board.

The "Electrical World's" House-Warming.—Our esteemed contemporary, the *Electrical World*, has recently moved into new quarters, and now occupies a building specially erected for this and the other journals published from the same office. The structure, which is called the Thirty-Ninth Street Building, is of reinforced concrete, with a frontage of 126 ft., and consists of 11 floors and a basement. High-speed electric elevators are installed, which with the lighting and power installation are supplied with electricity from the street mains. A large printing plant is being put in, and will occupy three floors. Not far away is the new Engineering Societies Building, and the General Post-Office, from which our contemporary has never strayed far. The *Electrical World* first appeared as *The Operator* in 1874, and is, next to ourselves, the oldest electrical journal continuously published. We extend our hearty congratulations to our *confrères* on their house-warming.

Arc Light Burns.—A great fuss has been made in some of the daily papers about an incident which recently took place at Portsmouth. The torpedo lieutenant of H.M.S. *Berwick*, Mr. N. F. Usborne, undertook to bore a hole in a turret with the electric arc, the matter being very urgent. Naturally, a good many of the officers and crew had a look at the unusual sight, and many of them, including Lieut. Usborne (who wore goggles), afterwards suffered severely from the usual effects of arc light burns, the skin peeling from their faces and their sight being temporarily lost. Evidently the phenomena were new to the correspondent who originated the story, for he dressed the incident in a garb of mystery, and belauded the ingenuity of the lieutenant. He may be interested to learn that the results which have astonished him are a matter of common knowledge to electrical men. Arc welding should never be carried on without metallic or other opaque shields over all exposed parts of the skin of the operator.

Warning.—Electrical men in London should be on their guard lest they should be imposed upon by a man of about 40 years of age, who is representing himself as having returned to this country in ill-health and need after 15 years' residence in Canada as an employé with an electrical undertaking in Montreal. He states that his case has been taken up by the Institution of Electrical Engineers, which is allowing him 5s. per week out of the Benevolent Fund, and that others in electrical circles are moving in his behalf. He asks for some joint action to be taken in order that he may be admitted as an in-patient in one of the Hospitals for Consumptives, and ends by asking for "milk," he having to take so many pints a day. Since his call at the Electrical Review office, we have ascertained that so far as the Institution of Electrical Engineers' knowledge of, and allowance to, him is concerned, the story is nothing but a fabrication, and other gentlemen whom he named as taking an interest in the matter have denied any knowledge whatever of the man. *Verb. sat. sap.*

Electric Power and Works Employment.—In the course of a speech to his shareholders last week, Mr. Whitelaw, chairman of the Highland Railway Co., said that during the half-year, in consequence of having introduced electrical power into the more extensive portion of their workshops, they anticipated that they would not be compelled to put their workmen upon halftime this year. They hoped to be able to employ them in the shops full time. "We are enabled to do that chiefly from this fact: Having got electrical power, there is no wastage of power to put the works on a half-day on Saturday. When you had to get up steam there was a considerable amount of power left over when the men ceased work in the middle of the short day. We used to have all the expense of getting up power and only got a half-day's work. This year as the men leave the shops the electrical power will be turned off, and so there will be a considerable saving. By this organisation, which we have developed during the last six months, we anticipate we shall be able to maintain the full term in our workshops in Inverness this year."

The installation referred to is of 170 H.P. The motors were supplied Messrs. Electromotors, Ltd., and Messrs. Bruce Peebles and Co., Ltd. The installation was carried out by the North of Scotland Electric Light and Power Co., Ltd., from whom the supply of power is also obtained.

Carborundum Rectifier.—In a paper published in the *Physical Review*, Mr. G. W. Pierce describes experiments on the power of carborundum to rectify alternating currents, due to the fact that it conducts much better in one direction than in the other. With a pressure of 30 volts, the current produced in one direction was 4,000 times as great as the current in the opposite direction. Using this property, D.C. measuring instruments may be adapted to measure alternating currents.

Institution of Electrical Engineers (Cape Town Section).—Mr. J. P. Edwards, M.I.E.E., chief engineer to the General Post Office, delivered his presidential address at the meeting of this Section held recently at the South African College. Mr. Edwards reviewed the work done by the Section during the year, when seven papers were produced. With the object of protecting the public, a Bill was drawn up for presentation to Parliament, whereby a Board of Civil, Mechanical, and Electrical Engineers would be created, having powers to examine into the qualifications of all engineers desirous of practising in the Colony, and issuing licences to those competent in the various branches of the profession. In this way, it was felt that the public would be protected from embarking in schemes which were not financially and technically sound, whilst dangers to life and limb, as well as dangers from fire, would be safeguarded as far as possible. It was to be regretted that the Government found itself unable to bring forward the measure this session. An Advisory Board should, however, be established, which would exercise functions analogous to those of the Local Government Board at home in dealing with municipal loans, &c. Mr. Edwards then proceeded to review the position of the electrical industry in South Africa to-day, and its recent advances. Having described the Johannesburg electric lighting and tramway undertaking, he gave some of the reasons that led to the failure of the generating plant, one of the most expensive and deplorable failures of recent times. It was, he said, to be most keenly regretted that at the present time, when depression reigns supreme, this serious calamity should befall the most important town in the country. Having referred to the Victoria Falls scheme of electric transmission, which appeals to one chiefly as a daring conception, and contrasted it with the practical results at Niagara, the lecturer passed to the recent installations of lighting and power at Indwe, at Port Elizabeth, and at Muizenberg, giving interesting details of each. He then proceeded to speak of the recent improvements in incandescent lamps. Coming to telegraphs and telephones, Mr. Edwards stated that at the end of last year the Colony had 8,200 miles of line and 32,000 miles of wire installed, excluding 7½ miles of cable, whilst 5,500 miles of wire are installed for the telephone system. He stated that whilst simplex working is used on branch telegraph lines, for the main lines duplex and quadruplex are necessary, and Wheatstone automatic working for news telegrams. In view of the progress that has already been made, it is anticipated that with improved apparatus and methods, it will be ultimately possible to transmit telephonic messages over these same lines simultaneously.

A vote of thanks was proposed by Mr. Giles, and seconded by Prof. Bohle.

Electric Shock Fatalities.—A Calcutta newspaper reports that a young Hindu student named Radha Benooe Neogy, of Raja Rajbullab Street, who was in the habit of carrying out sundry electrical experiments in his house, left home about 11 p.m., and threw a piece of copper wire over the tramway electrical overhead wire, in Upper Chitpur Road, "to study the effect." "Seeing that the contact of the two wires had produced sparks of fire, and fearing serious developments, he ran away. Shortly after, two Hindu women passing that way came in contact with one end of the loose copper wire which was trailing the ground, and were so severely injured from the shock as to necessitate their removal to the Mayo Hospital, where one of them died. The other woman is still detained under treatment. A charge of causing death by a rash act has been entered against the student, who is awaiting trial."

At the Old Park Works of the Patent Shaft and Axletree Co., Wednesbury, John Brennen, a blacksmith, of Hart's Hill, Dudley, received a fatal electric shock while cutting a piece of iron with an electric saw. Two other men were also injured, and one (Thos. Costello) was removed in a serious condition.

Electric Horticulture.—Mr. B. H. Thwaite has submitted to the Royal Horticultural Society a report on the progress made with his electric system of culture at the Royal Botanic Gardens. The results obtained during the first month, using electric light only, are considered satisfactory.

Liverpool and District Electrical Association.—The first social in connection with the above Association was held at the Queen's Café, Victoria Street, Liverpool, on Saturday, September 28th, the chair being taken by Mr. Myer. An excellent musical programme was rendered. There was a suitable interval for social intercourse. Mr. Samuel Frith, the hon. secretary and treasurer, then addressed the meeting as to the objects of the Association, and stated that all persons interested in electricity were eligible as members. Those present were invited to accompany the Association on its visit to the Widnes and Runcorn transporter bridge and power station on Saturday, October 5th, per 3.35 p.m. train from Lime Street.

Blackpool Electricity Works Extension. — On Tuesday last the formal inauguration took place of the sixth extension of the generating plant in the Corporation electricity works. The chairman of the Electricity and Tramways Committee, Alderman J. Brodie, gave a brief historical account of the undertaking, and was followed by the vice-chairman, Alderman J. Grime, and Mr. Pearson, who was the first chairman of the Electricity Committee in 1891; since 1893, when it was opened, the station has been entirely transformed, the original small rope-driven sets having been replaced by modern plant. The present extension consists of a Willans & Robinson turbine, coupled to a Dick, Kerr alternator for lighting, and a Brown, Boveri dynamo for traction, this arrangement having been adopted on the recommendation of Mr. Charles Furness, borough electrical and tramways engineer. The new set was started by the Mayor, Mr. S. Hill, who was presented with a gold key to open the lock and chain which held the stop valve closed by Mr. Mayhew, on behalf of the contractors. The Mayor closed the field switches of both generators, and in a few minutes these were carrying the whole of the lighting and tramway load, the rest of the generating plant being shut down. The ceremony was entirely satisfactory and successful. In our next issue we shall give further particulars and an illustration of the new plant.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—According to the *Sussex Daily News*, owing to the death of the superintendent of the Southwick power station of the Brighton Corporation electricity undertaking, the staff is being re-arranged. The Lighting Committee will ask the Town Council's sanction to the appointment of MR. CLAUGHTON, assistant superintendent, to the vacant post, his salary to be increased from £234 to £260. It is not proposed to fill his place, but three shift engineers are each to have their salaries raised from £2 10s. to £2 15s. a week.

MR. CHARLES D. BURNET, electrical engineer, and MR. G. G. SCURFIELD, assistant electrical engineer, to the Carlisle Corporation, have sent in their resignations, which the Electricity Committee has accepted. We are informed that Mr. Burnet's resignation is not to take effect until March next.

MR. W. B. TURNER, who, as previously stated, has resigned his position at the electricity works, High Wycombe, was last week presented by the staff and employés of the company with a mahogany case containing a solid brass rolling parallel, together with an illuminated address signed by the subscribers. MR. J. H. HODGSON, senior shift engineer at the Electricity Works, High Wycombe, has been promoted to the post of chief assistant.

MR. J. EDGAR, late of Edinburgh, has been appointed mains superintendent at the Corporation Electricity Works, South Shields.

The following changes have taken place in the Hanley Corporation Electricity Department:—MR. E. FORD, accounts and correspondence clerk, has been appointed to a similar position in the West Ham Corporation electricity offices. MR. S. G. MARSTON, senior charge engineer, has been promoted to the position of mains superintendent. MR. J. E. BRIDGMAN, charge engineer, of Stalybridge, has been appointed charge engineer at Hanley.

MR. J. R. WILSON, of Heston and Isleworth's Electricity Works, Hounslow, was last week appointed second engineer-in-charge at the Ilford U.D.C. Electricity Works at a commencing salary of £120, rising to £150 per annum.

At a gathering of the staff of the Glasgow Corporation Electricity Department (Port Dundas station), MR. A. L. SALTON was presented with a marble time-piece on the occasion of his marriage. Mr. R. W. Paterson, resident engineer, presided and made the presentation.

General.—MR. A. H. STANLEY has been appointed general manager of the Metropolitan District Railway Co. in place of Mr. Collinson, who has resigned. Mr. Stanley commenced his duties on September 26th.

MR. R. BORLASE MATTHEWS now has an office at 1, Victoria Street, Westminster, S.W., as well as at Swansea.

It is announced that COL. J. J. MELLOR, one of the directors and formerly chairman of the Metropolitan Railway Co., has resigned his seat owing to continued ill-health. MR. THOMAS PARKER, who is at present consulting engineer to the company, has been elected to a seat on the board.

MR. C. E. VORMEISTER, A.M.I.E.E, of the Eccles Corporation electricity staff, has been appointed instrument maker and lecturer in electric wiring and fitting at the Royal Technical Institute, Salford.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Consolidated Supply Co., Ltd. (London) (85,838).—Issue on September 11th of £970 5 per cent. debentures, part of series created July 18th, 1906, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £12,725.

Maxim Electrical Co., Ltd. (London) (84,426). — Issue on September 11th of £2,000 5 per cent. debentures, part of series created by resolutions of May 16th and November 29th, 1906, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £12,200.

A.B.P. Accumulator Co., Ltd. (Stockton-on-Tees) (in liquidation) (76,438). — A memorandum of satisfaction to the extent of £1,545 10s. 7d. of first mortgage debentures, dated March 20th, 1903, securing £7,500, has been registered.

General Electric Co., Ltd. (67,307).—This company's annual return was filed on August 14th, when 25,000 preference and 34,587 ordinary shares had been taken up out of a nominal capital of £800,000 in 40,000 preference and 40,000 ordinary shares of £10 each. £10 per share has been called up on 18,000 preference and 9,587 ordinary, and £275,870 has been paid. £320,000 is considered as paid on 7,000 preference and 25,000 ordinary. Mortgages and charges: £200,000.

United River Plate Telephone Co., Ltd. (23,654).—This company's annual return was filed on August 14th, when 100,000 ordinary and 40,000 preference shares had been taken up out of a nominal capital of £1,000,000 in 100,000 ordinary 40,000 preference and 60,000 unclassified shares of £5 each. £5 per share has been called up on 84,000 ordinary and 40,000 preference, resulting in the receipt of £620,000. £80,000 is considered as paid on 16,000 shares. Mortgages and charges: £300,000.

Electric Supply Corporation, Ltd. (52,036).—This company's annual return was filed on August 27th, when 42,000 shares had been taken up out of a nominal capital of £250,000 in £5 shares; £5 per share has been called up on 35,000, resulting in the receipt of £174,990; £10 remains in arrears; £35,000 is considered as paid on 7,000. Mortgages and charges: £54,955.

Newarc Lamp Syndicate, Ltd. (92,801).—This company's statutory report, filed September 9th, shows 5,107 shares taken up out of a nominal capital of £6,000 in £1 shares. £1 per share has been called up on 1,107, and £1,107 has been received. 4,000 shares are considered as fully paid. No mortgages or charges registered.

Crompton & Co., Ltd. (27,200).—This company's annual return was filed on August 18th, when 85,000 shares had been taken up out of a nominal capital of £300,000 in 100,000 shares of £3 each. £249,000 has been paid on 83,000 shares, and £6,000 is considered as paid on 2,000. Mortgages and charges: £100,000.

Martin & Jellicoe, Ltd. (electrical engineers, London), (94,313).—Issue on September 13th of £1,000 5 per cent. debentures, part of series created same date to secure £10,000, charged on the company's property, present and future, including uncalled capital. No trustees.

Aluminium Corporation, Ltd. (92,846).—This company's statutory report, made up to July 28rd (filed July 26th), shows 250,007 participating preference, and 56,820 ordinary shares taken up out of a nominal capital of £500,000 in 440,000 participating preference, and 60,000 ordinary shares of £1 each. The ordinary shares are credited as fully paid, and the preference are payable wholly in cash, £121,239 15s. having been received in respect thereof up to the date of the report. A list of allotments made up to July 31st shows a further issue of 700 shares (class not stated), credited as fully paid. No mortgages or charges registered.

Electrical Power Storage Co., Ltd. (30,313).—This company's annual return was filed on July 31st, when 18,592 ordinary and 66 founders' shares had been taken up out of a nominal capital of £100,500 in 20,000 ordinary and 100 founders' shares of £5 each. £5 per share has been called up on 66 founders', and £4 per share on 3,152 ordinary, resulting in the receipt of £13,332 5s. 1d., including £474 5s. 1d. paid on four founders' and 405 ordinary shares forfeited. £77,300 is considered as paid on 15,460 ordinary shares. Mortgages and charges: £10,000.

Edmundson's Electricity Corporation, Ltd. (52,013).—This company's annual return was filed on September 16th, when the entire capital of £800,000 in 80,000 ordinary and 80,000 preference shares of £5 each had been taken up. £784,000 has been paid on 146,800 shares and £66,000 is considered as paid on 13,200. Mortgages and charges: £435,000.

Electric Construction Co., Ltd. (39,292).—This company's annual return was filed on August 6th, when 81,390 preference and 112,100 ordinary shares had been taken up out of a nominal capital of £400,000 in 50,000 preference and 150,000 ordinary shares of £2 each. £40,690 has been paid on 18,245 preference and 2,100 ordinary, and £246,290 is considered as paid on 13,145 preference and 110,000 ordinary. Mortgages and charges: £250,000.

H. R. Jones, Wilson & Co., Ltd. (electrical engineers, Liverpool) (94,289).—Particulars of £500 debentures, created by resolution of September 9th, 1907, have been filed pursuant to Section 14 (4) of the Companies' Act, 1900. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

D. Santoni & Co. (1906), Ltd. (electrical engineers, London) (89,277).—A second debenture, dated September 3rd, 1907, to secure £330, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: R. C. Power, 36, Museum Chambers, Bury Street, Bloomsbury, W.C.

CITY NOTES.

Willans & Robinson, Ltd.

THE directors in their report for the half-year ended June 30th, 1907, state that after the necessary adjustments involved in the recent reduction of capital, and after writing off the sum of £6,467 as depreciation (at Rugby), a profit of £18,275 is shown for Rugby, reducible by a loss of £2,234 at Queen's Ferry. The net profit is, therefore, £16,042, out of which the directors propose that dividends be paid at the rate of 6 per cent. per annum upon the preference shares, absorbing £10,000, and 10 per cent. per annum upon the ordinary shares (equal to 2 per cent. upon the original value), absorbing £3,333, and that the balance of £2,708 be carried forward. The premises and plant at Queen's Ferry having been

recently written down so heavily, further depreciation is for the present unnecessary. The remaining loss, £2,234 for the half-year, is less than Queen's Ferry's contribution to the two items of debenture interest and directors' remuneration, and there can, therefore, be no question that it is more profitable to keep the works open and employed, even upon the present inadequate scale, than to close them.

The meeting is to be held at Cannon Street Hotel on Wednesday, October 9th.

British Thomson-Houston Co., Ltd.

THE report for the year ended March 31st last (which is published in the *Financial Times*), states that during the period under review the company has contracted to supply to the Metropolitan Railway Co. 10 electric locomotives and the electrical equipment for several trains, most of which have since been delivered. The electrical equipments for heavy traction work heretofore supplied to various railway companies continue to give complete satisfaction, including the equipments used on the system of tube railways operated by the Underground Electric Railways Co., Ltd., all trains of which are equipped with the company's apparatus. The company has sold a number of turbo-generators during the year, the largest single contract being with the Liverpool Corporation for three of 2,000 KW. each. During the period under review the company has disposed of a large amount of securities and reduced proportionately its liabilities. The net amount realised by the sale of securities (after taking into consideration some additional shares acquired during the year) was £136,727, and the entire proceeds were used to reduce the company's indebtedness. This leaves the debentures and shares owned at March 31st, 1907, at £105,801, and also £54,600 in shares in a patent owning company, or a net reduction during the year in all securities of a little over £111,000. The trading profit for the year, after deducting general and technical expenses, discounts, debenture and other interest, amounts to £14,994. The amount carried forward from March 31st, 1906, was £4,124, making a total available profit of £19,119. The whole of this profit, with the exception of £1,071 carried forward, has been applied to various depreciations. On the balance-sheet of last year the balance of the excess cost of manufacturing incident to the establishment of the manufacturing business of the company amounted to £31,707 (£36,000 having been previously written off). Nothing was added to this account during the year, and the directors have decided to write off a further sum of £15,000, leaving a balance of £16,707, from which further sums will be written off from time to time until finally disposed of. The directors have resolved to depreciate apparatus, meters, supplies and special tools, &c., necessary for their production, by a much larger sum than heretofore, appropriating for the purpose this year £29,642. To take care of these heavy depreciations it has been decided to make use of the premium reserve account of £40,000.

Yorkshire Electric Power Co.—The half-yearly meeting of this company was held on Tuesday, at Leeds, Mr. A. G. Lupton presiding. The chairman, in moving the adoption of the report (see ELECTRICAL REVIEW, Sept. 6th, page 391), pointed out that the generation, distribution, management and general expenses exceeded the total receipts by £403, which debit was increased to £1,211 by interest on mortgages during the half-year. The increase of consumption was 850 KW. as against 445. The company had arranged with the Corporation of Brighouse to give it a supply for lighting, power and tramway purposes, and had also completed an agreement with the British Carbide Factories, Ltd., who had leased a part of the site at Thornhill, and were now proceeding to erect buildings, to be ready by the end of the year, in which they would manufacture calcium carbide on a large scale. The Carbide Co. had contracted to take a yearly supply equal to three times the present rate of sale. It was being realised that electro-chemical and electro-thermal processes, such as the manufacture of aluminium, &c., could be carried out as cheaply in England as abroad, and there would be a continued development of such industries in the company's area.

Folkestone Electricity Supply Co., Ltd.—The directors have declared an interim dividend of 2 per cent. on account of the year 1907.

South Metropolitan Electric Light and Power Co., Ltd.—The warrants for the payment of interest for the six months to October 1st, 1907, on 4½ per cent. first mortgage debenture stock have been posted.

Babcock & Wilcox, Ltd.—An interim dividend on the ordinary shares of 1s. 7½d. per share has been declared.

Sir W. G. Armstrong, Whitworth & Co., Ltd.—The directors have declared an interim dividend of 10 per cent. per annum on the ordinary shares.

Shawinigan Water and Power Co.—A dividend at the rate of 4 per cent. per annum has been declared for the quarter ending September 30th. According to our financial contemporaries, the earnings for August were $52,675, being an annual rate of revenue of $632,100. This revenue will soon be considerably augmented by the operation of several new important contracts for the sale of power. A contract for a total of 3,250 H.P. at $19 per H.P. was recently closed with a substantial Montreal manufacturing concern, the proceeds of which will be entirely net revenue, as the company will not be involved in any additional expense thereby, and notification has been received in a letter from the vice-president of the company of the conclusion of a further contract for an additional 2,000 H.P. to the Montreal Light, Heat and Power Co. This will make a total of 18,000 H.P. delivered over the Island of Montreal, for which the company will be receiving over $275,000 per year.

Electrical Securities Trust, Ltd.—The report, which was submitted to the meeting held on Tuesday at Edinburgh, states that the total number of shares allotted is 52,085, of which 51,578 are allotted as fully paid. 10,000 have been allotted to the nominees of the Alliance Trust Co., Ltd., in consideration for its underwriting an issue of £100,000 of first mortgage debentures; 38,078 have been allotted to Bruce Peebles & Co., Ltd., as part consideration for certain securities transferred by it to the company; 2,000 have been allotted to the Electric Conversion Syndicate, Ltd., as part consideration for certain securities transferred by it to the company, and 1,500 have been allotted to Arthur Elliott, of 4, Swanage Road, Southend-on-Sea, as consideration for certain securities transferred by him to the company. There has been paid in cash on each of the remaining 507 shares £1, making the total amount of the cash received by the company in respect of the shares issued wholly for cash £507.

Bruce Peebles & Co., Ltd.—The financial dailies state that in a circular issued to the preference shareholders, the directors state that it is not intended to pay the interim dividend on these shares, which is usually distributed at this time. "As shareholders are aware, however, there is a special reserve fund invested outside the business of the company for securing payment of the preference dividends. The fund is more than sufficient to pay the whole of the current year's dividend, and the matter will fall to be dealt with when the annual accounts are completed in March or April next."

Swansea Improvements and Tramways Co., Ltd.—For the half-year ended June 30th the gross receipts were £22,317, an increase of £613. After payment of debenture and other interest, and the amount payable to the Swansea Corporation in respect of the tramways and light railways leased, the net profit was £3,742, plus £2,000 brought forward. £1,000 is to be placed to reserve and depreciation fund, and the usual dividends paid on the 6 per cent. and 5 per cent. preference shares, carrying forward £3,442.

Mr. C. G. Tegetmeier presided at the half-yearly meeting of this company held at Donington House, Norfolk Street, W.C., on September 30th. Mr. W. G. Bond seconded the adoption of the report, and it was carried.

Calcutta Electric Supply Corporation, Ltd.—The directors have declared an interim dividend on the paid-up share capital of the company for the half-year ended June 30th last at the rate of 6½ per cent. per annum. The 1906 interim dividend was at the same rate. The dividend is payable on November 15th.

The number of units delivered to consumers during the five weeks ended August 30th, 1907, were 760,558, compared with 590,291 in the corresponding five weeks of 1906.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

Shanghai Electric Construction Co., Ltd.—32,000 shares of £10 each fully paid, Nos. 1 to 32,000.

And to appoint a special settling day in:—

Platinum Corporation, Ltd.—59,255 ordinary shares of £1 each 10s. paid, Nos. 1 to 59,255, and 36,244 deferred shares of 1s. each fully paid, Nos. 1 to 36,244.

Sungei Salak Rubber Co., Ltd.—41,000 shares of £1 each 10s. paid, Nos. 14,001 to 55,000.

Prospectuses.—*Karak Rubber Co., Ltd.*—This company has been offering an issue of 21,500 £1 shares at par.

The Banteng (Selangor) Rubber Estates, Ltd.—This company has been making an issue of 40,000 shares of £1 each, £30,000 being offered to the public. The company is to acquire the Banteng and Puchong Rubber Estates, Selangor (Malay States), comprising 1,904 acres, of which 360 acres have been planted with Para rubber trees.

Woking Electric Supply Co., Ltd.—Interim dividend at the rate of 5 per cent. per annum on the ordinary shares has been declared for the half-year to June 30th. This is the first dividend paid on the ordinary shares.

Calcutta Tramways Co., Ltd.—The directors have declared an interim dividend of 3s. 6d. each on the ordinary shares (being at the rate of 7 per cent. per annum, free of income-tax) for the half-year ended June 30th, 1907. Last year the interim dividend was at the same rate.

British Aluminium Co., Ltd.—The directors announce an interim dividend of 3½ per cent. on account of the year 1907.

Hove Electric Lighting Co., Ltd.—The directors have declared an interim dividend on the share capital at the rate of 8 per cent. per annum for the half-year ended June 30th last, payable on October 15th. This is at the same rate as the interim dividend for 1906.

MARKET QUOTATIONS.

Wednesday, October 2nd.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	38/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£16	..
a Copper Sulphate	per ton	£24 5	£1 15 dec.
a Lead, Nitrate	per ton	£32	£2 dec.
a ,, White Sugar..	per ton	£35	..
a ,, Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (75/80 %) ..	per ton	£30	..
a ,, Chlorate	per lb.	9½d.	..
a ,, Perchlorate	per lb.	9d.	..
a Potassium Cyanide	per lb.	7d.	½d. dec.
a Shellac	per cwt.	220/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks ..	per lb.	3d.	..
a ,, Cyanide (basis 100 %) ..	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£159	..
b ,, Wire, in ton lots ..	per ton	£177	..
b ,, Sheet, in ton lots ..	per ton	£163	..
p Babbitt's metal ingots	per ton	£56 to £172	dec.
c Brass (rolled metal 2' to 12') basis	per lb.	7½d.	..
c ,, Tube (brazed)	per lb.	10d.	..
c ,, ,, (solid drawn).. ..	per lb.	8½d.	..
c ,, Wire, basis	per lb.	8½d.	..
c Copper Tubes (brazed)	per lb.	10½d.	..
c ,, ,, (solid drawn) ..	per lb.	11d.	..
g Copper Bars (best selected) ..	per ton	£85	£3 dec.
g Copper Sheet	per ton	£85	£3 dec.
g ,, Rod	per ton	£85	£3 dec.
e ,, (Electrolytic) Bars ..	per ton	£70	£5 dec.
e ,, ,, Sheets ..	per ton	£86	..
e ,, ,, Rod ..	per ton	£74	£5 dec.
e ,, ,, H.C. Wire	per lb.	9½d.	½d. dec.
f Ebonite Rod	per lb.	8/6	..
f ,, Sheet	per lb.	9/-	..
n German Silver Wire	per lb.	1/7	½d. dec.
h Gutta-percha, fine	per lb.	5/8 to 6/6	..
h India-rubber, Para fine	per lb.	4/4 to 4/5	dec.
Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	52/4½	2/1½ dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£21 10 to £21 15	£1 inc.
g ,, ,, Sheet	per ton	£21 17 6	£1 inc.
m Manganin Wire No. 28	per lb.	9/-	..
g Mercury	per bot.	£7 7 6	2/6 inc.
d Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/2¾ to 1/4	..
p ,, rolled bars & rods	per lb.	1/3¾ to 1/5	..
p ,, ,, strip & sheet	per lb.	1/5 to 1/7	..
o Platinum	per oz.	110/-	..
e Silicium Bronze Wire	per lb.	11½d.	½d. dec.
Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
,, ,, in bars		£15 to £40	..
g Tin, Block (English)	per ton	£160 to £161	£2 inc.
n ,, Wire, Nos. 1 to 16	per lb.	2/1	1d. dec.
p White Anti-friction Metals—			
"White Ant" brand	per ton	£45 to £70	..
h Zinc, Sh's (Vieille Montagne bnd.)	per ton	£26	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Batu Tiga (Selangor) Rubber Co.—The directors have declared an interim dividend of 2½ per cent.

Anglo-Malay Rubber Co.—An interim dividend of 10 per cent. per annum on account of 1907 working is payable on October 15th.

Candle-Power Specifications.—In its latest call for tenders for incandescent lamps, the U.S. Government has adopted the mean spherical candle-power as a basis for rating efficiency, the initial consumption being specified as 3·76 watts per M.S.C.P., corresponding to 3·1 watts per M.H.C.P.

STOCKS AND SHARES.

Tuesday Evening.

After a spasm or two of strength within the last few weeks, markets are again relapsing into a dull condition of prices and business, which bodes little apparent good for the autumn. A number of new issues, including electrical varieties amongst them, are all ready for the public when the public appetite shows signs of greater keenness than it displays at present. To all outward seeming, however, most of the prospectuses will have to bide in the promoters' pigeon-holes for some time longer.

The railway imbroglio has fallen into a sort of transition stage, and some of the newspapers, as distinct from the rags, are rebuking railway directors for pursuing a policy of drift. Preparations are afoot, however, on both sides for a struggle if the crisis should reach a stage more acute than now prevails. Railway securities certainly have got into the rut of drifting, so far as their prices are concerned, and a number of quotations have been lowered this week. Central Londons are very dull, the Deferred falling 2 to 46½, but no movement occurred in City and South or Great Northern and City issues.

Economies introduced into the Central London have already given rise to complaints from travellers with regard to overcrowding, but the receipts of the line continue to be so unsatisfactory as to call for strict attention to the spending departments in every way consonant with the necessity for the retention and expansion of the traffics.

Metropolitan Consolidated at 38¾ is easier, but Districts kept firm at 11½.

Telegraph stocks have given way to a noticeable extent, upon the old, old fear of what the Marconi Company is going to do in the way of cutting out the senior concerns when it begins business upon a commercial basis. This consummation, according to rumour, is on the point of being attained, and the message-rate of 5d. a word for cables across the Atlantic is now announced. The Anglo-American Telegraph Company charges 1s. per word, and the company's stocks have been severely dealt with during the last few days. Anglo "B," the 6 per cent. Preferred stock, has fallen no less than 5 to 98½; the Ordinary is 1 lower and the Deferred the same. The company, of course, adopts a politely incredulous attitude with regard to its service being superseded by that of the Marconi Co., but stockholders had become uneasy and began to realise, so prices had to go down.

Direct United States shares have fallen even more heavily, in proportion to their size, and the Eastern group did not escape the prevalent scare. Eastern Ordinary stock is 3 lower, and Eastern Extension shares are 15s. down, while Westerns show 5s. loss.

Globe Telegraph and Trust Ordinary declined 10s., and the Preference 5s., the shares being *ex* 2s. and 3s. dividends respectively. The former movement may be taken as a fair indication of the investor's nervousness on the point of wireless telegraphy's possible success in competing with the cable work.

It seems rather an anti-climax to add that Marconi shares themselves have fallen. The price is about 19s. 6d., after having been 21s. 3d. bid.

Telephone issues are unchanged. There were a few Anglo-Portuguese Telephone Ordinary on offer in the neighbourhood of 22s. 6d., but they soon found a buyer. It is not often that the shares come to market at all; still less frequently at so low a price.

Payments of the interim dividend on Bruce Peebles Preference shares has been postponed until the company's year closes. The company has a reserve fund hypothecated to the service of the Preference interest, and there is sufficient to its credit for the whole year's dividend to be met. We believe shares have changed hands recently at 25s. and 35s., although the Official List price was inaccurately retained at 3½ to 4, which quotation has now been removed from the pages of the list, and none other substituted so far.

Electricity supply shares are mostly either inanimate or lower. An exception is to be found in the Ordinary shares of the Metropolitan Electric, where 5s. rise took the price to 5½. St. James's, however, are easier, and so are both kinds of Westminster Electric shares. London Electric Ordinary and Preference each fell ⅛, but declines of similar amount in the case of Bromleys and Folkestones are due to the dividends deducted last week. There has been a useful lessening of the unduly wide margin between the buying and the selling prices of Bromptons.

Victoria Falls Power shares are quoted at nominally about 7s. 6d. discount. It is, perhaps, well to emphasise this price in view of the very optimistic statements which Mr. R. D. Mershon, the United States authority, and one of the consulting engineers to the Victoria Falls Power Company, made to interviewers last Saturday.

Traction issues are slightly dull, except those of the British Columbia Electric Railway. The Deferred stock of this company has risen 3, and the Preferred 2 points. British Electric Tractions have been very weak indeed. Anglo-Argentine Ordinary gave way, after allowing for the dividend of 4s. on the shares. Belgrano Second Debenture is 2 up. Canadian General Electric fell 3, to 106.

The Willans & Robinson report is read as satisfactory, but it has not sufficed to alter the price of the shares. British Aluminium were rather sharply affected by a seller coming into a market where the dealers did not want to take more shares for the present; the Ordinary fell to 4½. Telegraph Constructions are down 10s. and Henley's 5s. British Thomson-Houston Debenture remained at 87; the report came out early in the week.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Sept. 24th.	Closing Quotations Oct. 1st.	Business done week ended Oct. 1st, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3½	3 — 3½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	85 — 88	85 — 88	..	..	..	5 13 8
666,660	Anglo-American Telegraph	Stock	61s.	2⅜%	3½%	3⅞%	59 — 62	55 — 58	59	56	— 4	6 13 7
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5⅛%	6 %	6 %	103 —104	97 —100	102½	97½	—5	6 0 0
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	⅛%	1⅜%	16½ — 16⅝	15½ — 16	16⅛	15⅜	— ¼	10 18 9
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	5 %	99 —102	99 —102 xd	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6⅝ — 7⅛	6⅝ — 7⅛	..	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	91½ — 93½	90 — 92 xd	92	90½	..	4 7 0
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	6⅝ — 7⅛	6⅝ — 7⅛	..	..	..	6 13 4
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15½ — 16½	15½ — 16½	..	..	..	5 19 5
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅝ — 3¾	3½ — 3⅝ xd	..	..	— ⅛	5 14 3
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	9 — 9½	9 — 9½	..	..	..	5 5 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	8 18 2
60,710	Direct United States Cable	20	3 %	3½%	4½%	4½%	14⅜ — 14⅞	12½ — 13½	14⅜	12½	—1⅛	7 3 0
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	133 —138	130 —135	134½	130	—3	5 3 8
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	86 — 88	85 — 88	85	..	— ½	3 19 7
1,895,705	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	103 —105	103 —105	103	..	..	3 19 1
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅜ — 13⅛	11⅞ — 12⅜	13⅛	11⅞	— ⅜	6 18 10
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	102½ —104½	102 —104	..	..	— ½	3 16 11
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	97⅛ —100⅝	97⅛ —100½	..	..	..	3 19 7
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
181,127	Globe Telegraph and Trust	10	5⅛%	5⅜%	5½%	5½%	10⅛ — 10⅜	9⅞ — 10⅛ xd	10⅝	9⅞	..	5 7 4
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	12⅝ — 13⅛	12 — 12¾ xd	13⅛	13	..	4 8 11
150,000	Great Northern Telegraph, of Copenhagen ..	10	15 %	24 %	24%	20 %	34 — 36	34 — 36	35	34½	..	5 11 1
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	55 — 57	55 — 57	..	..	..	5 14 0
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3⅜%	64 — 67	64 — 67	64½	..	..	5 4 6
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	64 — 67	64 — 67	..	..	..	5 19 5
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅞ — 1	⅞ — 1	..	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	6 %	..	1⅛ — 1⅜	1⅛ — 1⅜	22/-	18/9	— 1/6	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞ — 1	1 — 1⅛	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 —108	106 —108	107½	106½	..	5 11 1
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5 %	106 —108	106 —108	107½	106	..	4 12 7
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10¾ — 12½	10¾ — 12½	..	..	..	4 16 0
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	12½	..	..	4 3 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	..	..	4 10 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..	3 1 3
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	101½	..	..	3 18 1
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6¼%	6¾%	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 1 10
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	4 11 6
100,000	Do. do. do. 4 % Red. Deb. Stock ..	100	..	..	4 %	4 %	91 — 94	91 — 94	..	..	..	4 5 1
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	127½	127	..	4 12 4
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6⅝ — 7⅛	6⅝ — 7⅛	..	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
15,609	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10½	10 — 10⅝	..	..	..	3 16 2
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	3 12 9
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930. ..	10	7 %	7 %	7 %	..	13 — 13½	12⅛ — 13½	13	12⅛	— ½	3 13 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	7/16 — 9/16	7/16 — 9/16	8/9	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %†	6 %	5 %	8 %	7⅞ — 7⅞	7⅞ — 7⅞	..	..	..	10 5 9
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	Nil
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	8 %	8 %	8 %	8 3/16 — 8 7/16	7 13/16 — 8 1/16 xd	8 1/16	7 31/32	..	4 18 6
260,007	Do. 5¼ % Cum. Prefs., 1 to 260,007 ..	5	5¼%	5¼%	5¼%	5¼%	5 13/16 — 6 3/16	5 13/16 — 6 1/16	6¼	6 3/16	..	4 8 11
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	131 —134	131 —134	..	..	..	4 9 7
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 8
880,000	Babcock & Wilcox, 1 to 880,000	1	17 %	20 %	20 %	20 %	3 15/16 — 4	3 15/16 — 4	77/6	..	..	5 0 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 3/16 — 1 5/16	1 3/16 — 1 5/16 xd	..	..	..	3 16 10
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	7 %	4 3/16 — 4 5/16	4 — 5	92/6	..	— 3/9	7 0 0
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	5 — 5 3/16	4 7/16 — 4 5/8	5 1/16	..	— 3/9	6 10 3
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	4 3/16 — 4 5/16	4 1/16 — 4 3/16	97/6	..	— 1/3	6 0 0
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3 15/16 — 4 1/16	3 15/16 — 4 1/16	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5¼%	96 — 99	96 — 99	..	..	..	5 11 1
400,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	6 %	6 %	127 —132	130 —135	133½	132½	+3	4 8 11
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	111 —115	113 —117	..	..	+2	4 5 6
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	104 —107	104 —107	..	..	..	4 13 6
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250 ..	40	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	2⅛ — 2⅝	1⅞ — 2⅛	45/-	35/-	— 1/3	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	6⅛ — 6⅝	5⅞ — 6⅛	6¼	5 13/16	— 3/9	9 8 3
1,448,553	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	100 —103	97 —100 xd	..	..	..	5 0 0
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	78 — 81	78 — 81	..	..	..	5 11 1
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6¾ — 7	6¾ — 7 xd	..	..	..	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	85 — 89	85 — 89 xd	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1 — 1⅛	1 — 1⅛	..	..	..	Nil
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	62 — 67	62 — 67	65	..	..	5 19 5
50,000	‡ Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅞ — 1⅛	⅞ — 1⅛	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	Nil	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	⅞ — 1⅛	⅞ — 1⅛	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	83 — 86	83 — 86	..	..	..	5 4 8
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	68 — 71	68 — 71	..	..	..	6 6 9
100,000	Buenos Ayres & Belgrano, 1 to 100,000 ..	5	3 %	4 %	3 %	3 %	4⅛ — 4⅜	4⅛ — 4⅜	90/6	90/-	..	3 4 0
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜ — 4⅝	4⅜ — 5 xd	97/6	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅜ — 4⅝	4⅜ — 5 xd	..	..	..	5 14 3
13,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	100 —103	102 —105	..	..	+2	4 15 3
137,610	Calcutta Trams, 1 to 137,610	5	6 %	8 %	8 %	8 %	7 — 7⅛	7 — 7⅛	7⅜	..	..	5 6 8
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,390.	5	..	..	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	102 —106	102 —106	..	..	..	4 4 11
35,000	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	9⅜ — 10⅜	9⅜ — 10⅜	10⅜	..	..	7 0 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 6 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105¾ —107¼	105¾ —107¼	..	..	..	4 3 4
491,223	Cape E Trams., 1 to 491,222	1	10 %	5 %	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	— 1/32	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1 3/16 — 1 5/16	1 3/16 — 1 5/16	25/6	25/3	..	6 1
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	97 —102	..	..	..	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	63 — 65	63 — 65	64⅛	64½	..	6 3 1
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	88 — 90	88 — 90	88	..	..	4 8 11
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	47 — 50	45 — 48	45	..	—2	8 6 8
1,480,000	City and South London Railway	Stock	2⅜%	2⅜%	1⅞%	2⅜%	45 — 47	45 — 47	46⅛	46	..	4 10 5

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Sept. 24th.	Closing Quotations Oct. 1st.	Business done week ended Oct. 1st, 1907.		Rise + or Fall —	Present Yield per cent.
		*	1903.	1904.	1905.	1906.			Highest	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	3	2½%	2½%	2½%	5 %	1¾— 2	1¾— 2	..	..	..	7 5 5
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	97½	..	..	5 1 0
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	10 %	1⅜— 1⅝	1¼— 1½ xd	..	..	..	6 13 4
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1¼	1 — 1½ xd	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6%	6 %	13 — 14	13 — 14	..	..	..	4 5 9
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12⅞— 13⅜	12⅞— 13⅜	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	Nil	2½%	4⅛%	..	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..	9 8 3
17,139	Do. "A" shares, 01—017,139	5	Nil	2½%	4⅛%	..	2⅛— 2⅜	2⅛— 2⅜	..	..	..	8 6 9
819,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	83 — 86	83 — 86	..	..	..	4 14 2
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	89 — 92	87 — 90 xd	..	..	..	5 11 1
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	1/16— 1/8	1/16— 1/8	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	¾— 1½	¾— 1½	17/6	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	92 — 95	90 — 93 xd	..	..	..	4 6 0
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	1½— 1⅝	1⅜— 2 xd	..	..	..	20 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½— 10⅝	10½— 10⅝	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	11½— 12½	11 — 12	..	..	— ½	6 5 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛ xd	5	..	..	3 17 3
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105⅜—107⅞	105⅜—107⅞	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10%	5 %	10%	10 %	14⅛— 15⅛	14⅛— 15⅛	..	..	..	6 13 4
37,500	†Liverpool Overhead Railway, Ord.	10	13⅞%	1½%	Nil	Nil	1⅝— 1⅞	1⅝— 1⅞	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	7⅞— 8	7⅞— 8	..	..	..	5 14 11
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6¾— 7⅛	6¾— 7⅛	..	..	..	4 0 0
399,930	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6¾— 7⅛	6¾— 7⅛	..	..	..	4 0 0
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅞— 8⅛ xd	7⅞— 8⅛	..	..	..	5 14 8
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	82 — 86	82 — 86	..	..	..	4 13 0
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	1/16— 1/8	1/16— 1/8	2/-	1/6	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/16— 1/4	3/16— 1/4	16/10½	..	..	5 2 7
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 10 11
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	1/16— 1/8	1/16— 1/8	..	..	..	8 0 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16— 1/8	1/16— 1/8	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	31 — 33	30½— 32½	31¾	30½	— ½	5 9 1
150,000£	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99½—102½	99½—102½	..	..	..	3 18 1
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	55 — 58	55 — 58	..	..	..	8 14 1
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1½— 1⅝	1½— 1⅝	..	..	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3¾— 4¼	3¾— 4¼	..	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..	5 0 0

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5⅛%	5⅛%	5⅛%	4⅞— 5⅛	4⅞— 5⅛ xd	..	..	..	5 7 4
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 10 0
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7⅞— 8⅛	7⅞— 8	..	..	..	6 13 4
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅞— 8⅛	7⅞— 8⅛	..	..	..	4 4 10
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3⅜— 4⅛	3⅜— 4⅛	..	..	+ 1/16	6 1 3
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3⅜— 3⅞	3⅜— 3⅞	..	..	..	5 16 2
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅜— 3⅞	3⅜— 3⅞	..	..	..	5 16 2
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
49,436	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3¾— 4¼	3¾— 4¼	..	..	..	5 5 11
175,000£	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9 — 10	9 — 10	..	..	..	6 0 0
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	10⅓— 11⅔	10⅓— 11⅔	..	..	..	5 4 4
400,000£	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	122 —125	..	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	97 — 100	97 —100	..	..	..	4 10 0
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	4⅜— 5	4⅜— 5	..	..	..	4 0 0
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4⅜— 5	4⅜— 5	..	..	..	5 0 0
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	6½— 7⅛	6½— 7⅛	..	..	..	6 9 0
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10 — 11	10 — 11	..	..	..	5 9 1
400,000£	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..	4 2 7
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	⅛— 1	⅛— 1	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1¼— 2	1¼— 2	..	..	..	7 10 0
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	76 — 81	76 — 81	..	..	..	5 11 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅞— 5⅛ xd	4⅞— 5⅛ xd	..	..	..	5 4 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	5 — 5⅛	4⅞— 5⅛ xd	..	..	..	4 13 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6⅞— 7⅛	6⅞— 7⅛	..	..	..	6 4 2
21,000	Kensington and Knightsbridge Electric Ord.	5	12½	12 %	10 %	10 %	8¼— 9⅛	8¼— 9⅛	..	..	..	5 8 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1⅜— 1⅝	1⅜— 1⅝	..	..	— ⅛	6 16 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅛— 4⅜	4⅛— 4⅜	..	..	— ⅛	6 6 4
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	88 — 92	88 — 92	..	..	..	4 17 10
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8⅜%	10 %	10 %	8 %	4⅞— 5⅛	5⅛— 5⅜	..	..	+ ⅛	6 19 2
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅝— 5⅛	4⅝— 5⅛	98/9	..	..	4 7 10
220,000£	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	103 —107	103 —107	..	..	..	4 10 0
250,000£	Do. 3½ % Mort. Deben. Stock Redeem. Stock	Stock	3½%	3½%	3½%	3½%	87 — 92	87 — 92	..	..	..	3 16 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	8 %	6⅛— 6⅜	6⅛— 6⅜	..	..	..	5 18 6
75,000	Do. 5 % Pref., 1 to 75,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	11 — 12	11 — 12	..	..	..	6 5 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6⅜%	7 %	7 %	7 %	5⅛— 6	5⅛— 6	..	..	..	5 16 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7⅜— 8⅛	7⅜— 8⅛	7⅞	..	— ⅛	6 1 3
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅞— 7⅛	6⅞— 7⅛	..	..	..	4 14 11
150,000£	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	86 — 91	86 — 91	..	..	..	3 16 11
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	⅛— 1⅛	⅛— 1⅛	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 75	71 — 75	..	..	..	6 0 0
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	1⅞— 2⅛	1⅞— 2⅛	..	..	..	6 6 4
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	⅝— ¾	⅝— ¾	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 — 1⅛	1 1/16— 1 1/8	..	..	— 1/16	5 17 11
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	98 —101 xd	..	..	..	4 9 1
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅜— 2⅛	1⅝— 2⅜ xd	..	..	..	11 10 6
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2 — 3	1⅝— 2⅜ xd	..	..	..	8 13 11
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	94 — 97	92 — 95 xd	..	..	..	4 14 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	8¾— 9¼	8⅞— 9⅛	8⅝	..	— ⅛	6 9 9
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	5 — 5⅛	4⅞— 5⅛	5	..	— ⅛	4 3 9

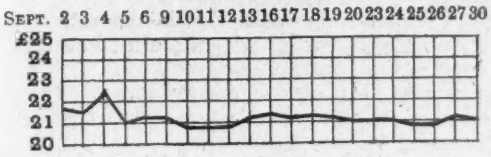
* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4½ per cent., August 15th 1907.

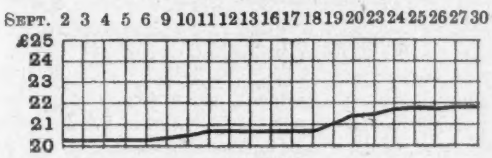
METAL MARKET.

Fluctuations in September.

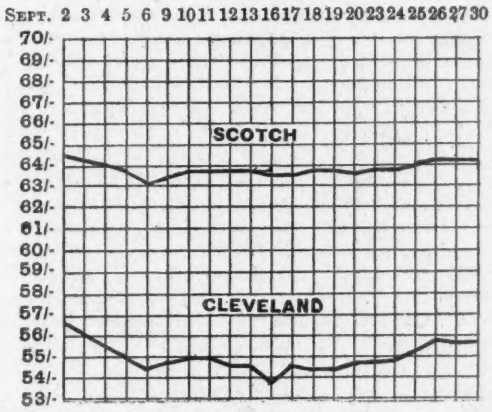
SPELTER (G.O.B's.).



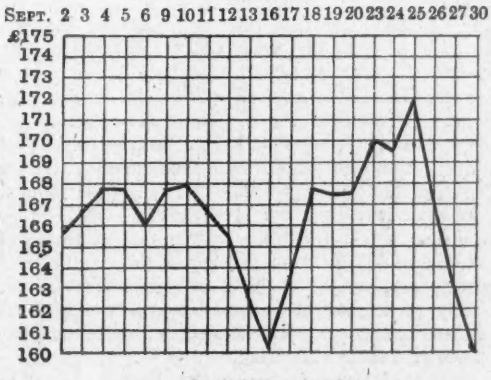
LEAD (ENGLISH).



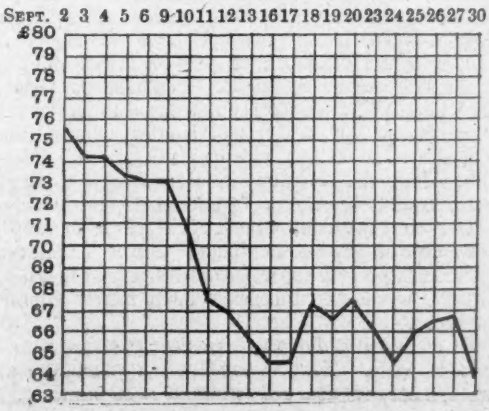
IRON.



TIN.



COPPER (G.M.B's.).



OF *MIXED* MATHEMATICS.

By W. M. M.

If a train be moving at 30 miles an hour, and continue so to move for four hours, it will in that time have travelled 120 miles. The calculation is within the mental grasp of any child, it is but multiplying the *number* of miles travelled per hour by the *number* of hours for which the journey lasts to get the *number* of miles travelled—that is to say, it is purely numerical. It is also hypothetical, the possibility of maintaining a speed absolutely uniform, and the limits of error due to the impracticability of that condition being left out of account. It can be made into a geometrical relation simply by retaining the word "miles" in the calculation; four times 30 miles is 120 miles, the *distance* run; but the "four" remains the *number* of hours. Lastly, the idea of velocity may be introduced, the four hours retained as a concrete period of time, and 30 miles per hour being regarded as 30 times as fast as 1 mile per hour, the unit *rate* of motion assumed, thus the statement becomes a kinematical proposition, as much beyond the mental vision of a child as the word "Kinematical" itself, and implicitly involving a question of metaphysics on which the most profound philosophers might be divided in opinion—viz., whether our idea of time, or that of rate of motion, be the more fundamental. The contention in this article is that the arithmetical and metaphysical questions should be kept distinct, and that the statement which is immediately comprehensible by the untrained intellect affords also the more scientific and more logical view of the matter.

The proposition above stated is a particular case of the general formula $s = v\,t$. On the arithmetical view s is the *number* of units of space passed over in t units of time by a body moving with a velocity of v units of space per unit of time. Thus s, v and t are all numbers (the word "number" being used to include fractions, commensurable and incommensurable). Now, in any treatise dealing with the dimensions of physical quantities, the proposition is laid down that the complete expression of any physical quantity consists of two parts, its numerical value and the unit in terms of which it is measured. That no one will dispute. But an inference is drawn that the complete expressions should enter into the equations, which thereby become more perfect expressions of the physical facts, and that, by examining the equations thus modified, clearer physical conceptions may be reached. This inference I believe to be illogical, and to lead often to false conceptions, though in certain cases it is extremely plausible.

The first objection to such a course is that it leads directly to a modification of the established meaning of symbols. This is by no means a fatal objection; the science of quaternions is founded on a re-statement of the meaning of equality, addition, multiplication and division. Provided the new definitions be intelligible and self-consistent, no confusion is introduced. At first, indeed, all seems plain sailing. The complete expression of the equation $s = v\,t$ becomes $s\,[\text{L}] = v\,[\text{V}]\,t\,[\text{T}]$ where [L] [V] and [T] are the concrete units of space, velocity and time. Also, since $s = v\,t$ numerically, it follows that $[\text{V}] = [\text{L}]/[\text{T}]$; or the unit of velocity is the unit of length divided by the unit of time; in C.G.S. units this becomes 1 cm./1 sec., and we have only to read the word "per" for the solidus to interpret it into the statement that the unit velocity is one of unit space per unit of time. But this gives us no new information; it is the assumption on which the equation $s = v\,t$ was founded on either reading of the symbols. It is, however, a legitimate use of the word, consonant with the analogy of 5 *per* cent, which means exactly the same thing as the fraction 5/100.

Similarly, if [A] be the unit of acceleration, the equation $[\text{A}] = [\text{L}]/[\text{T}^2]$ means that the unit of acceleration is one of a unit of velocity, defined as above, *per* unit of time; the index to the "T" being mere shorthand for a "*per*" twice repeated, not implying that there is any physical idea corresponding to the squaring of a second; but here, too, the equation tells us nothing that was not implicitly involved in the equation connecting the numerical values of the space and time in the motion of a uniformly accelerated body.

Similarly, the dimensional values of the units of force, torque, energy and work may be expressed in terms of the concrete units of mass, length and time without doing any great violence to the meaning of the symbols employed, though, also, without telling us anything not already implied in the definitions of those physical ideas, and in the choice of units whereby to measure them.

It is otherwise, however, with the dimensional equations of electrical and magnetic quantities, for here we are dealing with things in their nature unknown, which we are obliged to define in terms of some experimental properties arbitrarily selected. For example, it is an experimental fact that two electric charges repel one another with a force proportional to their product and inversely proportional to the square of the distance between them. This fact is expressed by the equation $q\,q_1/d^2 = f$, subject to the condition that the area and force shall be the repulsion between two unit charges at unit distance. Hence, introducing the "concrete" units we have :—

$$q\,q_1\,[\mathrm{Q}^2]\,/\,d^2\,[\mathrm{L}^2] = f\left[\frac{\mathrm{M\,L}}{\mathrm{T}^2}\right]$$

$$\text{whence } [\mathrm{Q}^2] = \left[\frac{\mathrm{M\,L}^3}{\mathrm{T}^2}\right] \text{ or } [\mathrm{Q}] = [\mathrm{M}^{\frac{1}{2}}\,\mathrm{L}^{\frac{3}{2}}\,\mathrm{T}^{-1}].$$

Here we have a perfectly arbitrary, and also a quite meaningless, relation introduced between the unit charge of electricity and the unit of mass. Meaningless, since no one can assign a meaning to the square root of a gramme; arbitrary, since it depends on the way in which we have chosen our units of charge and of force. Had we elected to take as our unit of charge the time-integral of the electromagnetic unit of current for one second, the relation would have been quite different; and, different again, had we taken the unit force as the gravitation force between two unit masses. The equation tells us nothing that was not implied in the experiment on which it was founded, and to look to it for any light on the nature of electricity is to imagine a vain thing. The system of interpretation which was credible in the simpler dynamical equations has also broken down, and such hopes as might be entertained of a calculus of concrete quantities must be abandoned.

Yet there is a sense in which these equations are not only intelligible, but helpful, though, for reasons to be given presently, not to be relied on too implicitly. That interpretation of them was urged nearly 30 years ago by no less a man than the late Prof. James Thomson, Lord Kelvin's brother, who entered a strong protest against the "concrete" view of physical equations. It is usually described as the "change-ratio" view of the dimensions. According to this view, the quantities [L], [M], [V], [T], &c., are just as much numerical as the s, m, v, t, &c., of the ordinary equations. They are the numerical values of the units themselves, and, therefore, if there be no change of units, they are all equal to unity and can be left out of the equations. If, however, the units be changed, these quantities are the numerical values of the old units in terms of those chosen for new. They correspond exactly to the "20" by which children are taught to multiply to reduce pounds to shillings, or the "16" to bring pounds to ounces. Were we perfectly free in our choice of units, we should have dimensional multipliers, but no dimensional equations. But we are not free. The majority of our physical formulæ imply some definite connection between the units, *e.g.*, the equation $s = v\,t$ is only true on the supposition that the unit velocity is one of unit space in unit time. Therefore, if the units chosen be, say, a foot and a minute, the unit velocity must be one of 1 ft. per min. When we change to other units, say, a centimetre and a second, [L] will be 30·4794, [T] be 60, and [V] must be the ratio of a foot per minute to a centimetre per second, *i.e.*, $\frac{30{\cdot}4794}{60}$, or ·50799. That is to say, the dimensional equations express certain arbitrary conventions which we have chosen to adopt in our *systems* of units. Sometimes it is convenient to ignore these systems. Thus the velocity of a train is generally measured in miles per hour, but its acceleration is an affair of seconds rather than hours, and it is most convenient to measure it in miles-per-hour per second. If it be so measured, however, the formula $s = \frac{1}{2}\,f\,t^2$ becomes no longer applicable, even though the acceleration be uniform, the conditions from which it was deduced being ignored.

On this method of interpretation such expressions as $[\mathrm{M}^{\frac{1}{2}}]$ are quite intelligible, for [M] being a numerical quantity, its square root is also a numerical quantity.

Let us apply the method to find the change ratio [Q] in an electrostatic formula when the unit of mass is changed to a quarter of a gramme, that of time to half a second, and that of length to four centimetres. Then [M] = 4, [L] = $\frac{1}{4}$ and [T] = 2.

$[\mathrm{Q}] = [\mathrm{M}^{\frac{1}{2}}\,\mathrm{L}^{\frac{3}{2}}\,\mathrm{T}^{-1}] = 2 \times \frac{1}{8} \times \frac{1}{2} = \frac{1}{8}$. That is, the new unit of quantity is eight times the electrostatic C.G.S. unit, and any quantity of electricity q that occurred in the equation would have to be written $0{\cdot}125\,q$ in the transformed equation.

Unhappily, this is a sort of problem that no one wants to solve, otherwise the "change-ratio" view of the dimensional equations would be better known than it is. To apply the equations to practical questions generally leads to a wrong result. For instance, the dimensions of current per unit of area are in electromagnetic units $[\mathrm{M}^{\frac{1}{2}}\,\mathrm{L}^{-\frac{3}{2}}\,\mathrm{T}^{-1}]$, but if anyone were to apply this formula to deduce the current density per sq. in. from that per sq. cm., he would get as multiplier 4·0481, whereas the real factor is 6·4514. The reason of the discrepancy is that the dimensional equations assume that all physical units will vary according to the professorial system. If you have a new unit of area the side of the square of that area must be the new unit of length. With an inch as unit of length the unit velocity and acceleration are changed, and with them the unit force. The distance between unit poles is changed, and so is the length of the arc in which unit current has to exert the new unit force on unit poles at the new unit distance. Hence follows a new electromagnetic unit of current and a new ampere. But the practical man wants none of these things, he wants amperes per sq. in. of cable section, or, perhaps, per circular mil; he doesn't mind a coefficient, but he has no patience with a system, however theoretically perfect.

But such objections apply equally to all dimensional equations. The advantage of the change-ratio system over the other is that every quantity occurring in a mathematical investigation is numerical, with which alone mathematics, as such, can deal (setting aside for the moment geometrical methods, and vectors, so far as their treatment is geometrical). This alone is a great gain, since it gives one much more freedom in working. To take an instance: the logarithm of x^2 is 2 log x. Now if x be any positive numerical quantity, log x^2 and 2 log x have each a distinct meaning. But if x denote some concrete quantity, such as a length, neither has any meaning at all. You cannot raise 10 to any power to make it equal to a yard or an acre. Hence one is debarred from logarithmic treatment of any equation containing concretes, such as the capitals in square brackets, considered as actual units, without introducing perfectly unmeaning expressions into the work. It is true that these expressions will, in practice, cancel out, but that does not give them a meaning.

I suspect that one reason for the disfavour in which the change-ratio view of dimensional equations is held, is that it leaves no room for suppressed dimensions. So long as the equations could be regarded as concrete relations between things-in-themselves, it was possible to talk vaguely of the discovery of the dimensions of some coefficient which should reconcile discordant systems of measurement; but when each "physical" dimension is understood to be the value of some unit expressed in terms of another unit of the same kind, the ratio of two like quantities; and when it is realised that the equations between them are simply the conditions that the choice of units shall always obey some arbitrary law, the main purpose of which is to keep down the number of physical constants; then it becomes evident that there is no path for physical discovery in that direction, and that "unknown" dimensions imply merely unformulated definitions.

We are usually allowed three degrees of freedom in our choice of units. However complex the system the units of length, mass and time are permitted to be arbitrary. Some

theorists have proposed to restrict this freedom still further, and have suggested that the astronomical unit of force, the attraction between two unit masses at unit distance should be made to agree with the dynamical unit, that which produces unit velocity in unit mass in a unit of time. The suggestion implies that the dimensions of mass should be $L^3 T^{-2}$. But this does not mean that mass is a certain function of space and time, a quite unintelligible question of metaphysics; it only means that we have chosen to be a little more professor-ridden than before.

There is one other use to which the dimensional formulæ may be put, namely, as a check on illogical or inaccurate reasoning. If two things are equal, their equality does not depend on the particular units employed in their measurement. Consequently any change of units throughout an equation must necessarily be the same in every term. This implies that the dimensions of the units must be the same throughout, and should that not be the case, there is some flaw in the argument. Of course the dimensions may be changed by division, differentiation, &c., but each equation must itself be homogeneous. For this test the formulæ are equally available in either form, but the change-ratio view of them is that by which the validity of the test is more immediately obvious.

Lastly, there can be no objection taken to such expressions as "power is of one dimension in mass, two in length and minus three in time," they are merely a concise way of summarising the definitions; nor is it disadvantageous to remember that *s*, say, stands for a length, and C for a current, throughout a calculation; provided it be also borne in mind that both are to be treated as numbers—one the number of units of length, the other the number of amperes. The dimensional concrete factors, with their square brackets, are too clumsy, happily, to be introduced into the calculations themselves, but sometimes they are read into their numerical coefficients, with a consequent loss of lucidity.

HIGH-TENSION TESTING ARRANGEMENTS IN A PORCELAIN FACTORY.*

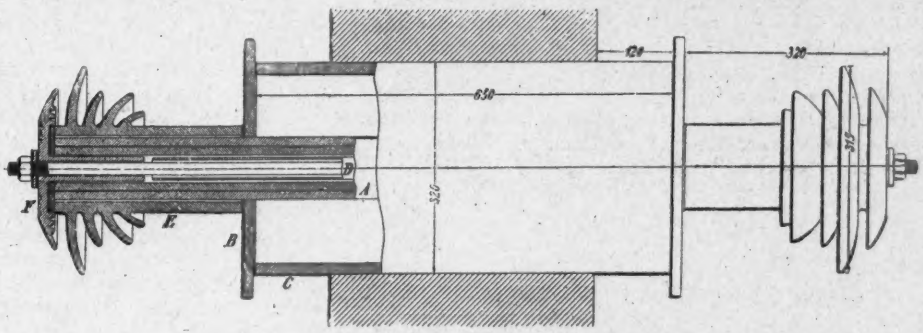
The requirements as regards high-tension testing in a modern insulator factory are constantly advancing, and it is of interest to note the way in which these requirements have been met in the recent extensions carried out at the Hermsdorf Porcelain Factory. The extensions became necessary partly because of the increased volume of the busines—the number of insulators to be tested having increased from 172,000 in 1902 to 562,000 in 1906—and partly because the existing maximum test voltage of 100,000 had become insufficient to meet the requirements of a large number of the orders. The new voltage adopted as a maximum was 200,000, and a transformer for this voltage, capable of developing 50 kw. under the ordinary intermittent test-room conditions without overheating, was ordered from the Siemens-Schuckert Co. The ends of the two high-tension coils of this transformer are brought out and can be connected either in series for 200,000-volt or in parallel for 100,000 volts by means of simple plug connections.

The transformer is provided with drying arrangements, safety valve and four safety spark-gaps fixed to arms on the lid of the earthed transformer case.

The primary voltage, as in the case of the older 100,000-volt transformer, is 78 volts, so as to suit the supply from a rotary converter driven from a 110-volt direct-current source. Besides this rotary converter, a separate alternator has also been installed. This is provided with six collector rings and a commutator, so that, if desired, it can be used as a rotary converter, but it is at present used as an ordinary single-phase generator. Both machines are controlled from a main switchboard from which overhead wires run to the two H.T. transformer boards in the laboratory. The dynamos are regulated from these transformer boards, the regulation of the new one being by means of a shunt resistance.

* *E.T.Z*, March 28th, 1907. K. W. Wagner.

The H.T. lines are supported from the roof above the test bed by means of a series of corrugated porcelain insulators connected together. The arrangements of the insulators for carrying the H.T. lines through the walls of the building have been considerably improved, as those previously used were not altogether reliable when damp. The new insulators are shown partly in section below. They have been arranged so that the parts more especially subject to breakdown shall be simple and easily replaceable without much expense, whilst the more complicated parts intended to prevent surface discharge through the collection of moisture are not subjected to direct electric stress. A is a long porcelain tube kept well away from the wall by means of the porcelain plates B. The hole in the wall is further coated by means of the porcelain cylinder C of 29 cm. inside diameter. The metallic connection itself is surrounded by the thin tube D of 4·5-mm. porcelain. This tube,



Porcelain Wall Insulator for 200,000 Volts.

owing to its small diameter, is subjected to the greater part of the electric stress, and is arranged for easy replacement. Over the tube A a multi-rimmed tube E is placed, whilst the danger of surface discharges between E and A is avoided by means of the special corrugated shield F. All these parts are separated by rubber disks.

These elaborate insulators were introduced partly in order to meet the requirements of the new water spray arrangements. Besides the previously-installed ceiling rose, three interchangeable side roses have now been fitted, as well as a portable rose which allows a side spray or an upward spay to be produced at any point. Further, the whole test-room can be filled with steam when desired. These arrangements are useful for comparative tests, but in order to obtain practical weather conditions the flat wood and cement roof of the test-room has been fitted up for open-air tests. Here large numbers of insulators can be tested for insulation resistance and for break-down voltage under normal working conditions.

The safety of the operators is ensured by a partly mechanical and partly electrical interlocking of the H.T. circuit closers with the doors of the test enclosures, so that no H.T. circuit can be closed as long as any of these doors are open.

Besides the electrical tests, complete arrangements for mechanical tests on the insulators are provided. There is a portable machine for subjecting insulators to a tensile or compressive stress up to 3,000 kg., as well as a larger stationary machine for carrying out tests on straining insulators, &c., up to 4,500 kg. The power to withstand blows, and the quality of the mounting, are also tested in a special falling-weight machine.

In order to avoid the trouble and inconvenience of testing each insulator at some multiple of its working voltage, the Hermsdorf Co. test all their insulators at the maximum voltage permitted by the surface discharge. For small insulators this voltage is three or four times the usual working voltage, and for moderate sized ones it is at least double the working voltage.

The larger complex insulators are tested in parts, so that the sum of the test voltages is at least equal to double the working voltage.

AMERICAN ELECTRIC TRAMWAY MATTERS.

A leaderette in the *Electric Railway Review* some time ago threw doubt on the superiority of grooved over circular trolley wire. A line having 75 miles of grooved wire has been so badly served by it that the management are substituting round wire as fast as they can. The grooved wire on careful examination showed nicks and flaws, and many breaks have occurred at these, or near the ends of the ears.

It is doubted whether grooved wire can be drawn with the same perfection of texture as round wire, and importance is attached to flexible suspension, long tapering ears, and small sag in the trolley wire.

If English managers insist on grooved wire, let them consider whether it is not sufficient to string up round wire and press out grooves for the ear at each point of suspension. Beyond that there is no conceivable use for the grooves, but several evident disadvantages.

When a tramway motor flashes over it is said in America to buck, and bucking occurs frequently on certain lines when high

speed is attained on a down grade with the controller "On." Popularly this has been attributed to the motor becoming a generator for the time being, as it does when the emergency brake is applied, but an editorial in the *Street Railway Journal* of April 6th exposes the error underlying this belief. So long as a series motor is connected to the line, current can pass in only one direction, however high the speed may rise. It constantly approaches zero but never attains it, and "bucking" is produced at high speeds by a combination of high potential difference between commutator bars and brushes, due to high counter E.M.F. and decreased drop across fields, bad commutation due to weak fields, and high peripheral speed of commutator tending to carry from brush to brush sparks caused by carbon dust ignited by the sparking of bad commutation and chattering brushes.

In the issues of both February 9th and April 6th the *Street Railway Journal* suggested that the unprecedented and unexplained state of the copper market called for the substitution of some other metal in electrical work.

There were few signs that copper was going down, and despite abundant statements that market operations had produced an artificial price and had kept it there or thereabouts for an unnaturally long time, the wiser heads agreed that the chief cause was the normal operation of economic laws, and that so long as the demand for copper continued, and vast new sources of supply were wanting, the price would remain at something like the ruling figure.

If the production of aluminium were not hedged about by patents, there would be a better chance of using it in competition with copper for distribution and transmission, and even now its use for these purposes is growing largely, especially since the difficulties of tensile strength and jointing have been surmounted.

Our readers are familiar enough with the arguments for aluminium, but they have not heard a great deal about iron and steel as a substitute for cables.

The *Street Railway Journal* speaks of old rails being welded or otherwise joined together and mounted bare on insulators in subways and on elevated structures, or buried in conduits filled with insulating compound. In some small degree these things have been done, and there is reason to think that the practice will be extended if neither copper nor aluminium falls greatly in price.

Aluminium at present does not offer much allurement to the electrical market, because its production is in a few hands, and its output is too limited to make much impression, but a few more years will see an expansion in the number of factories and the removal of the chief patent restrictions, while the high price of both aluminium and copper, and the extension of commercial enterprise beyond the coalfields and water-powers of the world, is driving engineers more and more to reduction of the sectional area of conductors by the use of very high pressures.

Bonding has been discussed so often in American journals, that there has been no possible chance of saying anything new for quite a long time, but Thos. B. McMath said all the old things brightly and with evidence of intimate personal knowledge at a Railway Association meeting in Dayton, Ohio, last March. In traditional style he traced the bond from its infancy as a piece of galvanised wire wrapped round a couple of rivets to its threatened disappearance under the competition of the welded joint. He insists on twist drills being ground accurately, which can only be done by a tool grinder; he distrusts soldered and brazed bonds, and will have nothing to do with the plastic bond, which ought to be quite dead by now; and he records that there are 40 miles of track in his town of Indianapolis with cast-welded joints on which the breaks have amounted to 1 per cent. in six years.

Until the Scioto Valley Traction Co. began running over the Columbus City grooved rails, no wheel troubles were experienced, but soon after that loose wheels became common, and worn flanges a nuisance.

Wheels were shifted inwards, and the gauge line of the flanges was ground away. The remedy for moving wheels was sought in raising the pressure at which they were put on to over 100 tons, and the sufferer would have us believe that all the trouble was due to the grooved rail, but he admits in discussion that the Columbus City tracks vary in gauge from 4 ft. 8¼ in. to 4 ft. 9 in. If the flanges did not wear, or the wheels shift on the axles, the cars could not keep to the rails at all.

In an issue of the *Street Railway Journal* of November, 1906, on which we have not yet commented, there appeared a valuable article on the diseases of cast-iron wheels in which the author explained the causes of such defects as uncircularity, swollen flanges, cracked flanges, comby tread, shelled-out tread, cracked spokes, wrinkles, slag and sweat. The list is formidable, but it should not be inferred that chilled wheels need be subject to any of the diseases mentioned, and the author catalogues them merely to put buyers on their guard. In fact, he says that when the vast number of these wheels in use is considered, and what a small percentage develop any diseases at all (except the universal disease of old age), it must be conceded that the makers are skilled in their art. This is particularly true since the introduction of high speeds and heavy wheel loads has introduced conditions under which unhealthy wheels must show up quickly.

The *Street Railway Journal* for April 6th contained a well illustrated description of the complex three-speed three-phase locomotive, of which Messrs. Ganz have built two for the Italian State Railways. Probably the Italians wish all electric locomotives far enough, as the Government finds money for experiments while leaving the railways throughout the country short of everything necessary to move merchandise.

These locomotives are equipped with one 12-pole motor of 1,200 B.H.P. and one 8-pole motor of 1,500 B.H.P. for a temperature rise of 75° F. in one hour. The two higher speeds are obtained each with one of the motors in operation alone, and the third or lowest speed is got by putting the motors in cascade. This is accomplished economically by varying the combination of windings of the stator in the 12-pole machine. The windings for each phase are split into three parts, the 18 ends being taken to a special switch. When the motor is used alone on 3,000 volts for the top speed the windings of each phase are in series, and the whole combination is star connected, but for the lowest speed the three coils of each phase are thrown into parallel, while the stator is connected in delta, so enabling it to be used on ⅓th of the line voltage. The 8-pole motor weighs 13·4 metric tons, the 12-pole motor 11·4 tons, and the whole locomotive 62 tons, while the weight on the two driving axles is 42 tons.

A poor description is given of an apparatus which has been developed for equalising the loads of two three-phase locomotives whose driving wheels have different diameters, and it is evident that this trouble was not anticipated when the first three-phase locomotives were coupled on one train.

Differences of 2 to 3 per cent. in wheel diameter must occur, and since the speed variation of a three-phase motor between no load and full load is no greater, one of the locos. may be fully loaded or overloaded, while the other runs without load, or even works as a generator at the expense of the first.

A special and elaborate form of water rheostat for the rotor circuits is used with apparent success to neutralise this trouble.

EXPERIMENTS ON SOLDERING.*

A Contribution to the Testing of Materials, by Adolf Lippmann Cologne.

(*Continued from page* 456.)

The question of the attacking of the metal is made still clearer by means of experiments with copper plates, which, at the suggestion of the author, were carried out by the above-mentioned authority. The certificate of test says:—

"Copper plates 10 × 10 cm. were made metallically clean with hydrochloric acid; they were then rubbed with chalk and dried with filter paper. On the plates prepared in this manner sample 4,250/1 (resin) was sprinkled in the form of a fine powder, and samples 4,250/2 (Fludor) and 4,250/3 (Tinol) were put on in thin layers.

"(*a*) After the samples 4,250/2 and 4,250/3 had been acting for four days at the normal temperature of the room, sample 4,250/2 was removed from the plate with benzine and the plate was rinsed with water. The benzine solution, together with the insoluble particles suspended in it, and the watery solution were mixed together and filtered with hydrochloric acid to decompose any copper soaps which had formed. The hydrochloric acid watery filtrate was then tested for copper by saturation with ammonia.

"Sample 4,250/3 was able to be removed from the copper plate with water and for the same reason was treated like sample 4,250/2 with hydrochloric acid. The hydrochloric acid watery solution was then also tested for copper. With sample 4,250/2, as well as with sample 4,250/3, the copper plate was externally unaltered. In the hydrochloric acid solutions no trace of copper could be found.

"(*b*) After the samples 4,250/2 and 4,250/3 had acted for one day at a temperature of 50° C., they were kept for 24 hours at the normal temperature of the room, and then similarly treated as in (*a*). The copper plates showed externally no signs of change. In the hydrochloric acid watery solutions no copper could be detected.

"(*c*) After being allowed to act for five minutes at a temperature of 230° C., samples 4,250/1 to 3 were cooled, and sample 4,250/1 was removed from the plate with ether, and then, like samples 4,250/2 and 3, as indicated under (*a*), treated with water and hydrochloric acid. No external change of the copper plates was noticeable with samples 4,250/1 and 4,250/2. The copper plate of sample 4,250/3 was coloured a metallic white at the place which had been covered with the soldering material.

"The hydrochloric acid watery solutions from sample 4,250/1 (resin), and 2 (Fludor) showed weak copper reactions (sample 2 weaker than 1); with sample 3 (Tinol) copper could not be traced.

"Whether in soldering other conditions obtain, which may lead to an attacking of the copper, must remain undecided."

Of very special interest here is the result that resin at the temperature of soldering attacks the metal more strongly than the solder preparation 4,250/2 (Fludor).

It is thus evident that serious consequences must follow, if the rules of the Verband Deutscher Elektrotechniker officially, and without further comment, declare that solders which attack metals are not to be employed, yet, at the same time, in officious elucidation permit the use of resin to be directly recommended. If, therefore, in the definition of these rules it is not explained that only the avoidance of unnecessarily strong acids is desired, which by negligent handling can give rise to bad after-effects, there may be conveyed in this expression a misconception of the soldering process itself. Meanwhile this consideration also appears to have taken root elsewhere; at least, the fact speaks for itself that the passage with reference to the attacking of the metal is absent from the new edition of the Society's rules.

* From the *Elektrotechnische Zeitschrift*.

The copper plate of sample 4,250/3 (Tinol 50/50) showed a metallic layer, according to the certificate of test. As the copper plate in consequence of the preparatory treatment was metallic and perfectly clean, on heating it the tin solder held in suspension in the Tinol flux could at once on melting combine with the copper, as in the process of soldering, and so formed a sort of protecting layer. Under these circumstances, the fact that there were no traces of copper in the residues is intelligible; if care had been taken to leave some of the flux on a part not covered with tin—as may easily happen in practice, by negligent handling of the material—the copper reactions would without doubt have resulted just as in the experiments of the author.

It would have been of interest had the remainder of sample 4,250/3 also been examined for tin, especially with reference to the doubt as to the durability of such solders so largely manifested in practical circles. It does not appear improbable that with solders which contain an excess of ammonium chloride solution, the metallic solder which is suspended in the soft mass as a fine powder does not long withstand the action of the acid which is formed by the slow decomposition of the sal-ammoniac. Without wishing to call into question the utility of such solders, it would nevertheless be advisable only to use them as fresh as possible.

At the January meeting of the Kölner Bezirks-Verein Deutscher Ingenieure, Dr. M. Corsepius gave an account of some tests with solders which had already been published in part towards the end of the spring. As I was allotted the task of testing a soldering material by means of analogous experiments, I took the opportunity of making a close study of these publications.

In making this study, and partially repeating the corresponding experiments, I became convinced that a clear exchange of opinion was as much needed in connection with the evidential value of *experimental* tests of solders as with reference to the influence of the acid, discussed above.

As regards the possible evil after-effects of solders, Dr. Corsepius made duration tests, a report of which will be found in *Elektricität* No. 52, 1906.

Manganin and nickelin wires, which had been several times soldered with Tinol, were loaded continuously for $1\frac{2}{3}$ months with 1·7 amperes per sq. mm. The experiment starts with the supposition that the so-called acid-free solders do not prevent the destruction of the soldered portions by electrolysis, as most solders contain hygroscopic salts, such as zinc chloride. "From this it results that the moisture adhering to the soldered parts conducts the current, and is decomposed by it. A secondary decomposition of the metal also takes place."

As the result of the duration test, it is stated:—"That the passage of the current has not produced any electrolytic action on the Tinol soldering, and also that no local secondary phenomena have occurred." Apart from the fact that the report has omitted any information as to the treatment of the soldered parts after the operation of soldering, objections might be raised against the evidential value of the experiment, as a comparison is wanting. In fact, it is questionable whether the same result would be not attainable with any kind of soldering material, perhaps even by soldering direct with hydrochloric acid, or zinc chloride, pre-supposing a most careful after-treatment. Unless it can be simultaneously established that with any other soldering procedure under exactly the same testing conditions destructive actions have actually taken place, the duration tests will prove nothing either in favour of the one kind of preparation or against the other.

The most useful way of conducting such experiments would be to prepare test-pieces soldered with different materials, one piece to be very carefully treated afterwards—possibly by boiling; another piece to be less carefully handled—possibly only rubbed off with a greasy cloth—and with one of the pieces all subsequent treatment to be omitted. The samples prepared in this way should then all be subjected to the same duration test. These tests would, doubtless, give information as to which material produced the least amount of harm with negligent handling. As by careful subsequent treatment one can obviate the bad after-effects due to the use of corrosive solders, such tests can, therefore, only refer to the consequences due to negligence, with which one certainly has to reckon in practice.

Experiments on tenacity, *i.e.*, tensile tests, can, under certain circumstances, afford reliable conclusions as to the efficiency of a soldering substance. A good soldered joint which is only held together by the solder can, in the most favourable case, attain the strength of the solder. In order to obtain comparative results free from objection, care will have to be taken in the preparation of the samples, that the pieces to be tested are only held together by the solder, *i.e.*, that no portion of the observed tenacity can possibly be ascribed to other causes such as, for instance, binding wires, &c.

Tensile tests with bound soldered joints, such as were described at the above meeting of the Kölner Bezirksverein Deutscher Ingenieure, cannot, therefore, be regarded as suitable for experiments on the usefulness of solders. Bound soldered joints are produced, as is well known, by bending up the two ends of the wires in the shape of a hook, laying them side by side—*e.g.*, for a length of 75 mm.—and then tightly binding them together with copper wire. As with this kind of wire joint the binding has really to provide the strength, the tenacity of the unsoldered joint will, in general, exceed that of the wire itself, so that with a tensile test the break occurs outside the joint even when unsoldered—*i.e.*, in the full cross-section. It is, therefore, obvious that such soldered portions—as is, indeed, confirmed in the above-mentioned report—throughout support a greater load than the full cross-section. As, however, with a bound joint such a result can occur *without* soldering, tensile tests on bound soldered joints afford no criterion of the goodness of the soldering material used.

Small differences in the magnitudes of the breaking loads certainly afford conclusions as to the influence of the applied source of heat on the strength of the wire, but not on the strength of the soldered portion. In this sense the sentence contained in the report of the test is to be interpreted:—"Soldering with the naked flame gave a somewhat lower tenacity than when carried out with the soldering iron." (Cp. "Mitteilungen des Kölner Bezirksverein Deutscher Ingenieure," Heft 2, 1907, p. 6.) These differences are based upon the fact that all drawn or twisted wires give varying results with reference to their breaking load, according as they are more or less annealed. The following consideration may be useful in arranging tests:—When heavy conductors are soldered into cable thimbles, the clear width of which is slightly larger than the diameter of the conductor, the soldered ends, when drawn out by force, should present clean sheared surfaces, if the soldering has been perfectly carried out. Starting from this standpoint, the cable thimbles of so-called motor-cable connectors, which are delivered filled with solder, were carefully unsoldered, and then 4·52-mm. (16 sq. mm.) wires soldered into them with Fludor and Tinol. On drawing out the wires by means of a Lohsenhausen testing machine (5 tons maximum load), the following results were obtained:—

Sample I (Fludor), 350 kg.; sample II (Fludor), 360 kg.; sample III (Tinol), 325 kg.; sample IV (Tinol) 310 kg. Samples I and II showed smooth, clean sheared surfaces when pulled out. The wires soldered with Tinol exhibited strongly tumid protuberances, to which moist, unused material was still clinging (fig. 3). In consequence of the strong frothing of the Tinol mass on heating, there remained inside the cable thimble a residue which, on cooling, was enclosed by the solder adhering to the edges.

At the same time this test showed that soldering materials which

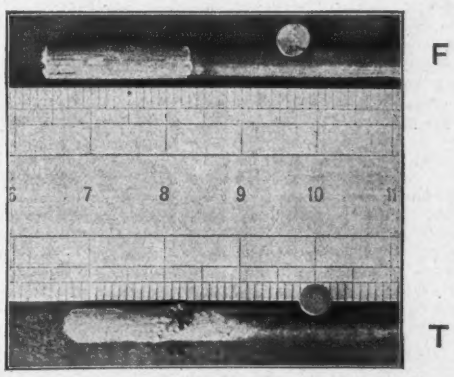


Fig. 3.—Soldered Wires pulled out of Cable Sockets.

contain the necessary soldering metal in a finely-powdered form cannot be universally applied. However seductive the thought may be that everything necessary for soldering has been combined, this kind of soldering material is less suitable for soldering in closed cable thimbles than for tinning free surfaces. Owing to the strong evolution of gas the liquid solder is driven out of the thimble to such an extent that it becomes very tedious to fill it up. Also in soldering a thick bundle of wire the large amount of solder which spurts out for the same reason may become very disagreeable. Experiments with "Lötan," a preparation equal in value to Tinol and containing the flux and solder combined as a finely-divided powder, led in this respect to similar results, although "Lötan" has the characteristic of forming much less gas.

To render the comparison still more free from objection, the above tensile tests were repeated for different materials with a slight modification. On carefully examining the drawn-out wires, it was observed that the solder, which had flowed through, had partially connected the end faces of the wires to the metal of the cable thimble, so that, in addition to the shearing, to a slight extent a tensile strain might have occurred. Although it could not be expected that this slight hold would materially affect the results, it was still deemed advisable, in order to meet possible objections, to exclude these influences in repeating the experiments. For this purpose 5-mm. thick circular disks of vulcan-asbestos, having the same diameter as the bore of the cable thimbles, were inserted in the latter, so that a soldered connection could now only take place on the circumference, but not on the front face, of the wire (fig. 4). After pulling out the wires in the testing machine, by means of a series of micrometer measurements the mean diameter and the mean length of the different cylindrical shearing areas were determined. If the shearing section so found be multiplied by the coefficient of shearing of the applied solder-alloy, and the force obtained in this manner be compared with the breaking load given by the testing machine, a figure can be obtained which serves as a measure of the goodness of the soldering—*i.e.*, its efficiency.

If d = the mean diameter,
l = the mean length of the shearing section,
k_s = the coefficient of shearing of the alloy,
$P_i = d\,l\,\pi\,k_s$, the force obtained from the experimental value of the shearing stress of the alloy,
P_e = the breaking load given by the testing machine,
then the efficiency of the soldering is given by—

$$\eta = \frac{P_e}{P_i} = \frac{P_e}{d\,l\,\pi\,k_s}.$$

The mean coefficient of shearing of the normal alloy of the metal solder (50 parts lead to 50 parts tin) was found by experiment to be 200 kg. per sq. cm. Using this value the experiments yielded the following figures:—

No.	Soldering material.	P_e kg.	l mm.	d mm.	η
1	Fludor	350	16	4·47	0·779
2	Tinol stick	380	19	4·45	0·715
3	Lötan	355	17	4·38	0·759
4	Zinc chloride	340	15	4·53	0·796
5	Resin	320	18	4·41	0·642
6	Fludor	350	16	4·40	0·791
7	Tinol	340	16	4·40	0·787

The figures are easy to understand; *e.g.*, in soldering with zinc chloride, 79·6 per cent. of the strength of the metal solder was reached; with resin the joint had only 64·2 per cent. of the strength of the solder used.

At the same time the table shows that a true comparison can only be made by measuring the actual shearing areas. The bare statement of the maximum load obtained by experiment does not suffice alone; in addition, the area must be known over which the breaking load is distributed.

To test the effect of high temperature, in experiments Nos. 6 and 7 the cable thimbles were held for another 30 seconds in the flame of the benzine soldering lamp after the solder began to flow. Whether the small protuberances that were obtained in experiments 6 and 7 are to be actually ascribed to the larger transfer of heat, I should not like to decide just yet from these experiments.

At most the supposition may be expressed that perhaps in this way information may be gained on the effect of the source of heat. This would, however, require a much larger amount of experimental work than the time of the author so far has permitted.

The fact will not appear strange that soldering with zinc chloride gave the highest value and with resin the lowest.

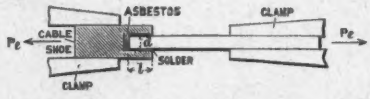


FIG. 4.—SECTION OF TEST-PIECE.

In carrying out tests of this description it is advisable, in soldering-in the wire, to wipe off the fluid solder evenly with, say, a piece of tin so that if possible the solder closes flush with the edge of the cable thimble. To facilitate the measurement of the length of the shearing area, the protruding end of the wire should be painted with iron varnish right up to the edge of the thimble after cooling and before it is placed in the testing machine.

The length of wire within the thimble is regulated by the physical properties of the wire, which should be determined beforehand. At any rate it should be so adjusted that the maximum load expected to pull out the wire will not stretch it, as the reduction in cross-section of the wire caused by an extension can produce quite different conditions.

That in such experiments extreme care should be taken to ensure the simultaneous fulfilment of all the testing conditions—that, for instance, the pieces of wire used should, as far as possible, exhibit equal surface conditions—requires no confirmation. If special importance be attached to ascertaining which material gives the best results in the presence of thick layers of oxide without previous cleaning of the surfaces, it would not be difficult to produce symmetrical layers of oxide of any thickness on a piece of wire previously brightened by dipping, the sections of which could then be used for the different samples.

It only remains to be said that by the adoption of a few precautionary measures there is nothing to prevent the above experiments being carried out with pieces of tin.

Judging from the experimental results obtained hitherto, it can, at any rate, be asserted that the method of testing described above permits of good comparisons. In addition, it is far less dependent upon secondary causes than, say, electrical tests, and has the advantage over these that it can be carried out with fewer apparatus and with less expenditure of time.

(To be continued.)

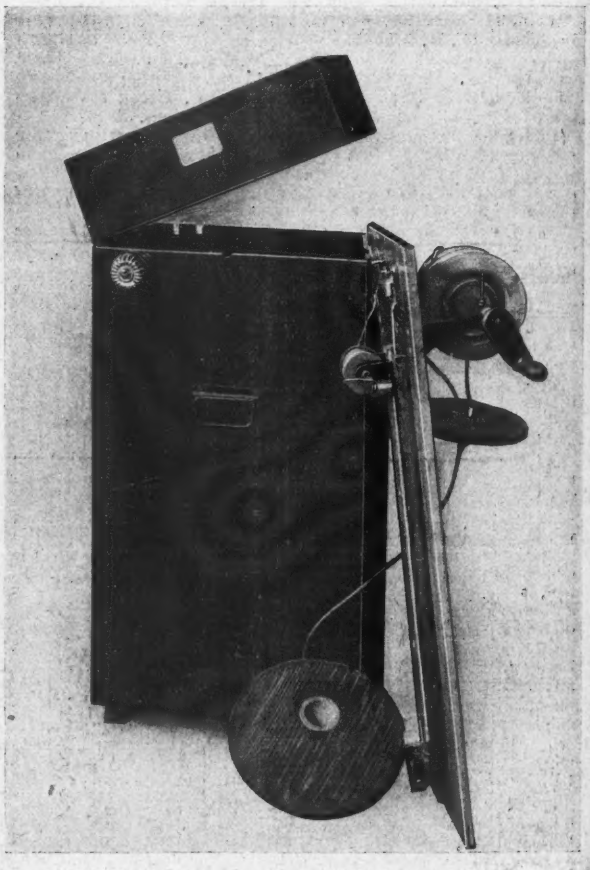
Russian Exhibition.—In December next an international exhibition of modern apparatus for lighting and heating is to be held at St. Petersburg, and a Lighting Congress will take place under the auspices of the Imperial Russian Technical Society, on January 9th and 20th, 1908. Medals and diplomas will be granted, and special tariffs will be charged on the Russian and other railways for the carriage of exhibits, which will also be admitted free of duty, provided that they are removed from the country after the Exhibition. The charges for space vary from 35 to 12 roubles per sq. metre. Full particulars can be had from the Exhibition Committee, through the Imperial Russian Financial Agency, 107, Cromwell Road, London, S.W.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The O.S. Liquid Starter.

These liquid starters have been designed to overcome the difficulties sometimes experienced in wire starters in connection with the no-volt release arrangement, possibility of starting-up too quickly, heating through starting too slowly, and also separately exciting the motor field, irrespective of the resistance in the armature circuit.

The starter is totally enclosed in a wooden case, with the starting handle projecting at one side. On turning the starting arm, the plunger is lowered through the liquid resistance, and a weighted magnet-shoe, fixed in a slide, is lifted, the raising of the latter immediately allowing the shunt switch to drop by its own weight before the plunger reaches the liquid, thus completing the shunt



circuit before the armature circuit is formed. The plunger is fixed to a wooden float of a slightly smaller diameter than the jar containing the liquid, compelling it to displace the latter before sinking, and therefore making it impossible for the armature circuit to be completed too rapidly. The plunger reaches the contact at the bottom of the jar before the magnet-shoe reaches the top of the slide, which then at once cuts out the liquid resistance. This weighted magnet-shoe is held up by means of a magnet coil (in series with the shunt circuit), so that the moment the main switch is opened the coil is demagnetised, allowing the magnet-shoe to fall by gravity, the weight of the magnet-shoe at the same time allowing it to draw up the plunger to the off position.

A resistance is inserted in the shunt circuit (which comes into play automatically as soon as the main switch is opened) to deal with the "extra" E.M.F.

The overload release is operated by a solenoid device. The liquid used is fireproof, and, unlike acids or soda, has very little effect on metals.

All the live parts are mounted on a polished slate partition to ensure perfect insulation, and the necessity for a mechanical joint through the porcelain jar for the return from the bottom contact is obviated by the use of two jars instead of one.

These starters are eminently suitable for motor hiring schemes, as only four sizes are required for dealing with motors up to 30 H.P.; the resistance solution is specially graded for any given horse-power, and can be altered or renewed in a few minutes at the cost of a few pence. They are made under the Olive and Swarbrick patents by the O.S. LIQUID STARTER AND DIMMER CO., of Pool Fold Chambers, Cross Street, Manchester

Igranic Motor Regulating Panels.

In the accompanying illustration (fig. 4) we show a number of "Igranic" motor regulating panels, which form part of a large order which has been received for foreign shipment by the Adams Manufacturing Co., Ltd., of 106, New Bond Street, W.

Dowsing Luminous Radiators.

The Dowsing Radiant Heat Co., Ltd., 24, Budge Row, E.C., are introducing several new types of their patent electric radiators for the coming season. Amongst these new designs may be specially mentioned a line in which use is made of Doulton Majolica ware, which, besides being perfectly hygienic, makes an attractive framing to the patent interior which contains the heat lamps with the special superheating arrangement for warming the air. New radiators for use in the dining-room or office have been devised with a flat top, and these will be useful to keep food warm. Other designs in black iron and copper, hammered copper, brass, &c., after the Sheraton, Adams, and new art styles, are listed in a range of prices for two, three, and four-lamp types, for all classes of consumers. We understand that there are several ships' radiators already supplied to the Admiralty and used on the new *Dreadnought*, all of which are fitted with the Dowsing patents. An illustrated catalogue for the season has just been issued, and this, together with a four-page circular, gives particulars as to prices. Fig. 2 is a fine specimen of artistic French design in hammered bronze. It is fitted with patent coppered reflector and fan-shaped interior. In fig. 3 we show a representative artistic example, with Majolica-ware frame in green art shade, fitted with coppered reflector and interior.

Fig. 2.—Dowsing French Design in Hammered Bronze.

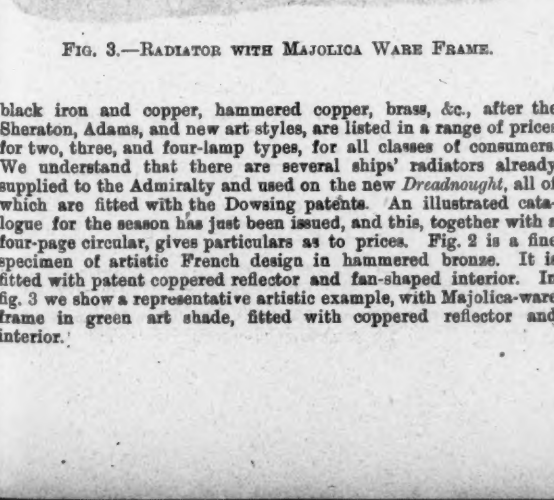


Fig. 3.—Radiator with Majolica Ware Frame.

Electric Heating.

The Electric and Ordnance Accessories Co., Ltd., of Stellite Works, Cheston Road, Aston, Birmingham, are putting two new electric heating systems on the market. The "River's" system, in which the heating units consist of specially designed tiles or bases carrying a patented resistance compound, which is practically indestructible, is essentially a low temperature one, and is stated to be preferred by many heating engineers for use in hospitals, sanatoriums, sick rooms, &c., where a very gentle heat is required. "Stellite" heaters on this system have been installed in the House of Commons, Buckingham Palace, &c., with satisfactory results. In the "Eclipse" system, quid units are employed which work at a higher temperature. These units are very light, with a negligible capacity for heat, and they commence heating the air immediately they are put on circuit. The special advantage claimed is the quick results obtained, while the simplicity and absolute reliability of the units and the compactness and extreme portability of the complete heaters are advantageous features also claimed for the system. Over 50 designs have been standardised—special attention being given to ship heaters, factory heaters, &c. We illustrate (fig. 5) a ship's heater, built to consume 1,500 watts, with temperature regulation, for ruby illumination, an art glass panel being provided. The case is of antique brass hand hammered, with hand repoussé work, and saw pierced panel and top.

The other illustration (fig. 6) shows a design suitable for use in dining room, drawing room, &c., of antique copper, hand hammered, with hand repoussé panel, art inlays for illumination, &c. The company's new catalogue will be published in the course of a few days.

A comprehensive catalogue of motor-starting gear has been

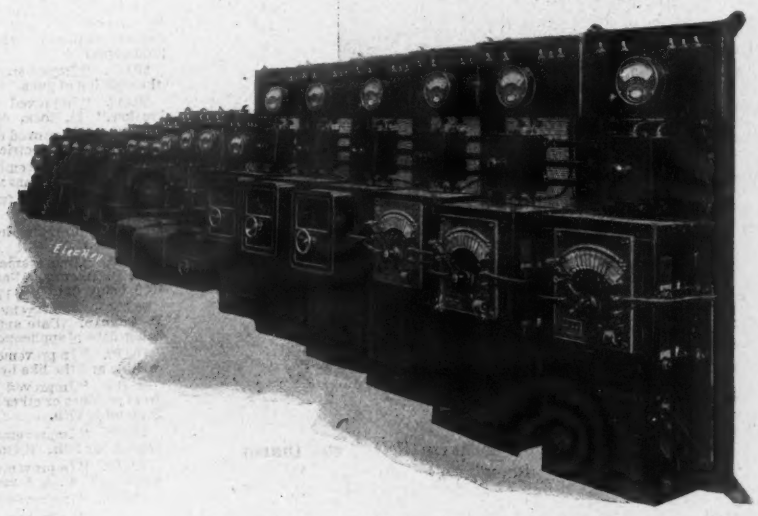


Fig. 4.—"Igranic" Motor Regulating Panels.

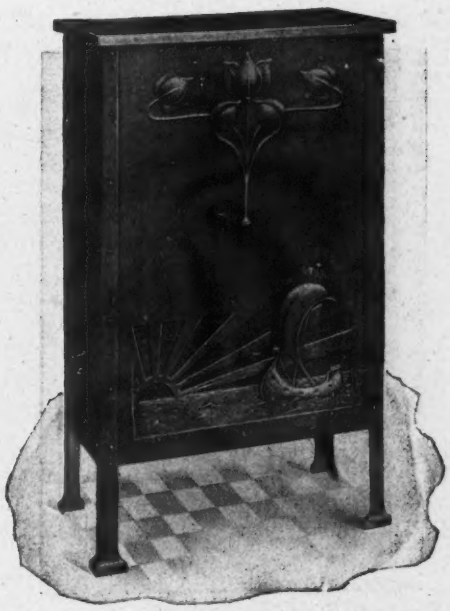


Fig. 5.—Electric & Ordnance Ship Electric Heater.

published by the company containing over 800 prices. We illustrate (fig. 7) an enclosed panel consisting of standard enclosed motor starter and the "Stellite" ironclad combined Q.B. switch and fuses. A complete range of panels and starters, all new designs, is now

Fig. 6.—Electric and Ordnance Heater for Dining Rooms, &c.

stocked. The Q.B. combined switch and fuses are claimed to be a considerable improvement. In it separate slate bases are provided for each pole, on which are mounted the patent self-aligning renewable copper contacts and sweating sockets, &c., the bases being thoroughly well insulated from the iron case, and the poles separated by a substantial insulating fillet.

The switch lever and all outside parts are insulated, an earthing terminal being provided. The resistance of the switch is low, and all current-carrying parts are of ample capacity, thereby obviating any possibility of heating. The make-and-break mechanism is simple in design, the actual quick make-and-break being operated by

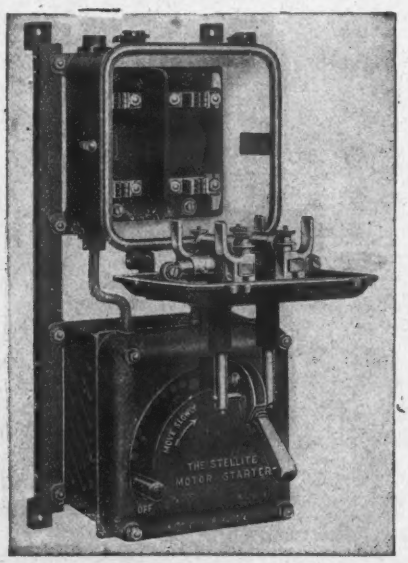


Fig. 7.—"Stellite" Enclosed Motor Starter and Combined Switch and Fuses.

the inclined angle pieces cast solid with the bottom case in conjunction with the two special plungers (fitted with steel pulleys) on the switch blade (brass), and fuse-carrying body. In closing the switch each plunger engages with one of the angle pieces, and is under compression until the apex of the angle piece is reached, when the compression is released, and, due to the inclined surface of the angle piece, the switch blades are rapidly driven home on the contacts, and a quick-make is effected. A quick-break is similarly obtained when opening the switch. The lever operates in a loose link; the cover is hinged and asbestos lined, and the switch is made watertight by a rubber gland inserted in the top of the bottom case. The switch is designed for house service and motor work.

NEW PATENTS APPLIED FOR. 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

20,539. "Automatic device for lowering an electric trolley pole when it leaves the wire." J. Randes-Willey. September 16th.

20,572. "Improvements in electrically-operated firearms." K. Beresford. September 16th.

20,592. "Improved electric secondary cell." P. Rabbidge. September 16th. (Complete.)

20,600. "Improvements in bridging blocks for dynamo-electric machines." E. Heitmann and F. W. Young. (Date applied for under Patents Act, 1901, October 18th, 1906, being date of application in United States.) September 16th. (Complete.)

20,603. "Improvements in electrostatic potential meters." Allgemeine Elektricitats Gesellschaft. (Date applied for under Patents Act, 1901, September 15th, 1906, being date of application in Germany.) September 16th. (Complete.)

20,609. "Improvements in electrical transmitting apparatus for controlling the sighting of guns." A. T. Dawson and G. T. Buckham. September 16th.

20,612. "Improved electro-magnetically controlled cut-out or circuit-breaker." H. Rose. September 16th.

20,619. "Improved electric lamp-holder, with improved shade carrier-holder, for bayonet cap electric lamps." C. M. Escare and C. Damey. September 17th.

20,639. "Improvements in filling joint boxes to protect the joints of electric cables." E. A. Claremont. September 17th.

20,650. "Electric furnaces." H. L. Hartenstein. September 17th. (Complete.)

20,651. "Carbon holders." H. L. Hartenstein. September 17th. (Complete.)

20,670. "Improvements relating to mercury interrupters for electric currents." L. J. B. Drault. (Date applied for under Patents Act, 1901, September 21st, 1906, being date of application in France.) September 17th. (Complete.)

20,676. "Improvements in electrically-operated switching and other devices." F. Conrad. (Date applied for under Patents Act, 1901, September 20th, 1906, being date of application in United States.) September 17th. (Complete.)

20,682. "Improvements in or connected with the reproduction of pictures, writing and the like by electricity." S. O. Cowper-Coles. September 17th.

20,688. "Improved process for the recovery of metals from their ores or from residues or other substances containing the metals." S. O. Cowper-Coles. September 17th.

20,688. "Improvements in controllers for motor vehicles." A. Winton. September 17th. (Complete.)

20,689. "Improvements relating to the control of electrically-driven vehicles." E. A. Jeffreys and W. B. Sayers. September 17th.

20,748. "Improvements in electrical fuses." J. Jeffreys. September 18th.

20,774. "Improvements in and relating to electric switches." British Thomson-Houston Co., Ltd., and E. B. Wedmore. September 18th.

20,788. "Improvements in electric batteries for medical purposes." H. J. Haddan. (W. Thompson and J. C. Martin.) September 18th. (Complete.)

20,812. "Improved shutter for the lenses of stage arcs, binocular magic lanterns and other such devices." W. Pollard. September 19th.

20,814. "Improved electric cable or conductor connecting devices or means." British Insulated and Helsby Cables, Ltd., and H. Allen. September 19th. (Complete.)

20,824. "Improvements in electric oscillographs." J. T. Irwin. September 19th.

20,867. "Improvements in and relating to alternating-current machines of the commutator type." Allgemeine Elektricitats-Gesellschaft. (Date applied for under Patents Act, 1901, September 20th, 1906, being date of application in Germany.) September 19th. (Complete.)

20,878. "Improvements in and relating to motor-driven clocks, electrically controlled." I. H. Parsons and A. E. J. Ball. September 20th.

20,901. "Improvements in central-battery telephone exchange systems." J. A. Romer. September 20th.

20,906. "Improvements in automatic electrical signals for colliery inclines and the like." R. Reed. September 20th.

20,919. "Improvements in or relating to magneto machines chiefly for the ignition of internal combustion engines." J. D. Bell. September 20th.

20,920. "Improvements in magnetic ore separator." L. S. Burt. (W. M. Currie, Federated Malay States.) September 20th.

20,932. "New method of manufacturing moulds used in the electrolytic manufacture of so-called honeycombed radiators and apparatus connected therewith." E. Friedheim. (Date applied for under Patents Act, 1901, November 27th, 1906, being date of application in France.) September 20th. (Complete.)

20,947. "Method of inserting former-wound coils of flat copper into the slotted iron cores of electrical machines." Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke G.m.b.H., Germany.) September 21st. (Complete.)

20,948. "Method for reducing disturbances in telephone and telegraph lines." Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke, G.m.b.H., Germany.) September 21st. (Complete.)

20,949. "Improvements in the control of electrically propelled vehicles and other apparatus." Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke, G.m.b.H., Germany.) September 21st. (Complete.)

20,986. "Improvements in or relating to magneto machines, chiefly for the ignition of internal combustion engines." J. D. Bell. September 21st.

21,017. "Improved means and apparatus for regulating the ignition of internal combustion engines." S. Sanders and J. W. Dean. September 21st.

21,030. "Improvement in magnets for lifting." Markische Maschinenbau-Anstalt L. Stuckenholtz A.-G. (Date applied for under Patents Act, 1901, March 21st, 1907, being date of application in Germany.) September 21st. (Complete.)

21,035. "Improved method of electric motor control and apparatus therefor." W. C. Yates and W. O. Lum. (Date applied for under Patents Act, 1901, September 22nd, 1906, being date of application in United States.) September 21st. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool price, post free, 9d. (in stamps).

1906.

Means for Compensating Load Variations in Electrical Installations. J. Y. Johnson. (Felten & Guilleaume Lahmeyerwerke Akt.-Ges.) 11,853. May 21st.

Filaments for use in Electric Lamps, Furnaces, or other Apparatus. The British Thomson-Houston Co., Ltd. (General Electric Co., U.S.) 18,488. August 17th.

Methods of Purifying Metallic Compounds. The British Thomson-Houston Co., Ltd. (General Electric Co., U.S.) 18,489. August 17th.